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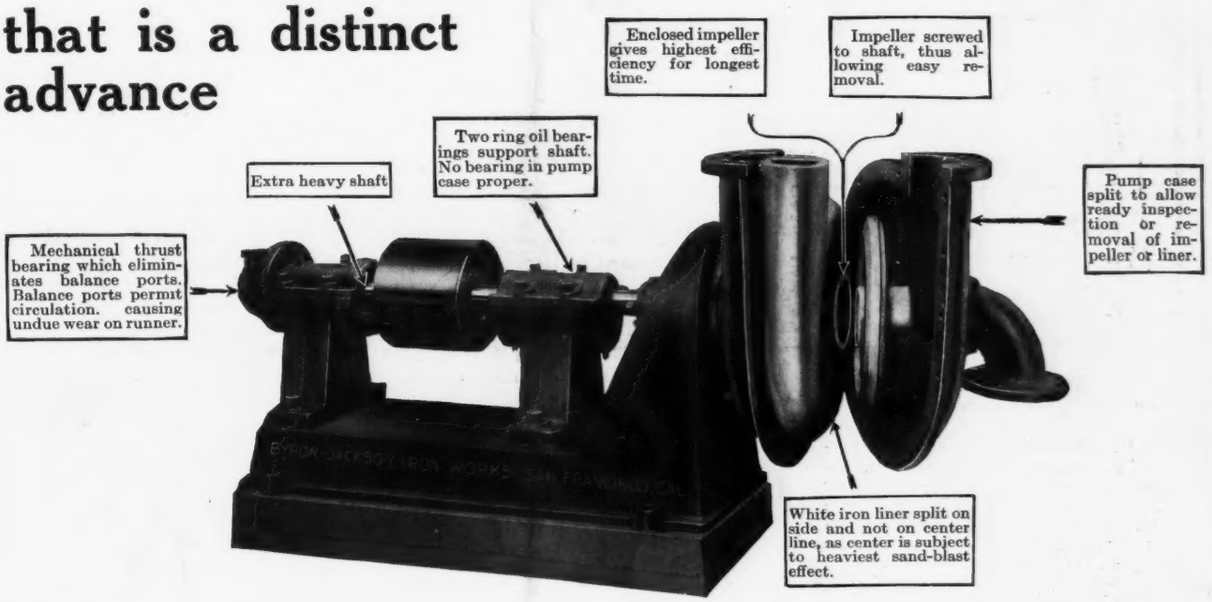
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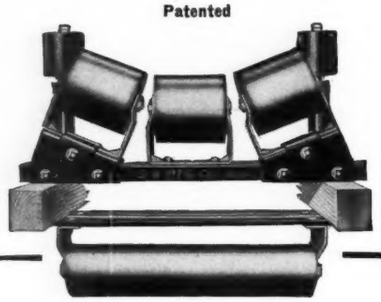

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Engineering and Mining Journal

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Sulphuric Acid from Copper Smelting Gases

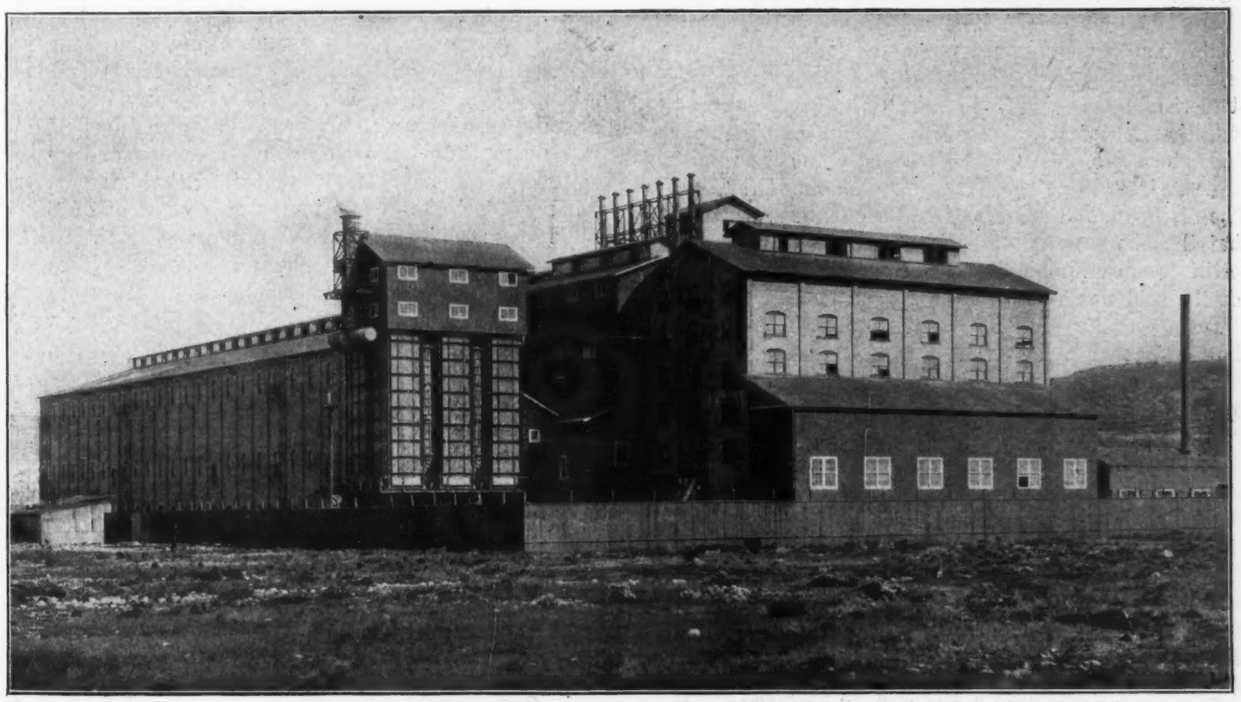
By E. L. Larison*

SYNOPSIS—The four largest acid plants in the United States operating on gases from copper smelteries are those of the Mountain Copper Co., Mococo, Calif.; Tennessee Copper Co., Copperhill, Tenn.; Ducktown Sulphur, Copper and Iron Co., Isabella, Tenn.; and Anaconda Copper Co., Anaconda, Mont. Details of acid manufacture at each of the plants are given. They all employ the old chamber method rather than the newer contact process, for which reasons are given.

The last 10 years, and particularly the last three years, have witnessed developments in the metallurgy of copper and zinc which involves the use of large quantities of sulphuric acid. These are, of course, leaching and flotation. It is almost always desirable to make the acid at the works using it, because transportation is expensive, and if smeltery gases are available, acid can be made for much less than it can be bought.

There are at least four copper-reduction works in this country that have sulphuric-acid plants of consequence operating on gases made in the regular course of the reduction of the ores. These are the Mountain Copper Co., whose acid plant at Mococo, Calif., was erected about 12 years ago; the Tennessee Copper Co., whose first unit was built nine years ago; the Ducktown Sulphur, Copper and Iron Co., whose plant at Isabella, Tenn., was put into operation about eight years ago; and the plant at the Washoe Reduction Works at Anaconda, which began operating about 18 months ago.

The Mountain Copper Co. plant uses gas from McDougall type roasters, the sulphur-bearing material being fines from the company's heavy sulphide ores. This ore carries 48 to 50% sulphur. The calcine is treated along with other materials, in reverberatories. The acid plant consists of six Meyer tangential chambers with suitable Glover and Gay-Lussac towers. The output is about 35 tons of 100% acid or 45 tons of 60° acid per day.



ACID PLANT OF WASHOE REDUCTION WORKS, ANACONDA, MONT.

While this happens to be an ore and a process with copper production as the chief end, they are also well suited for acid making. In fact, the company sells this

*Metallurgical engineer, superintendent acid department, Anaconda Copper Co., Anaconda, Mont.

same ore to other firms particularly for acid making. There are no particular novelties or differences in the process from the conventional chamber-plant burning such as that, for example, employed at Rio Tinto.

Acid from Pyritic Smelting in Tennessee

The Tennessee Copper Co. and the Ducktown Sulphur, Copper, and Iron Co. both use gases from blast furnaces. The Ducktown ores are unusual. They are heavy sulphide ores, the iron mineral being largely pyrrhotite with only a small proportion of pyrite, and the copper mineral being chalcopyrite. The following is an analysis of a typical sample: Pyrrhotite, 29.50%; pyrite, 5.82; chalcopyrite, 7.89; blende, 4.23; magnetite, 7.73; quartz, 15.59; silicates, 22.74; calcite, 2.16; and dolomite, 3.56%. The quantitative analysis of this ore is: Cu, 2.74%; Fe, 30.37; S, 18.87; SiO, 26.96; CaO, 66.70; MgO, 2.97; Mn, 0.34; Zn, 2.80; AlO, 2.91.

The reduction practice of both companies is the same. The ore is taken directly from the mines to the furnace bins with no preliminary dressing whatever. It is smelted in water-jacketed blast furnaces with from 4 to 6% coke and a small amount of quartz. A matte is made carrying 12 to 15% copper. This is run into beds, broken up, and resmelted with a sufficient amount of quartz on the charge to produce a 40 to 50% Cu matte. The process is about as near to true pyritic smelting as is attained anywhere.

When these two companies first attempted the manufacture of acid from blast-furnace gases, it was not known just how seriously detrimental to the process the high CO_2 content and the irregular SO_2 was going to be. There were no precedents. It was supposed that the CO_2 would tend to segregate, producing dead corners and perhaps blanketing the bottom acid. It was not a very attractive undertaking, technically. There were two conditions that made it necessary and possible to make acid. The Supreme Court decision in the Georgia case made it imperative to do away with most of the smoke. The fortunate and redeeming feature of the situation was that the plants are situated in the center of the greatest fertilizer-consuming district in this country. A market for the acid was assured.

Tests on the gas delivered by the blast furnaces showed that when they were in good condition, there was an almost complete consumption of the oxygen blown in. By this is meant when no bad crusts or blowholes existed in the charge. This phenomenon was first noted by Robert Sticht in his pyritic work in Tasmania. It was many times confirmed at the Ducktown plant. Some doubt has been expressed at times as to the reliability of these results on account of using metal pipes for drawing the samples in some cases. Numbers of these tests were later made with silica tubes in the gas stream, so that no consumption of the oxygen by the hot metal of a pipe was possible.

Air Admission Complicates Process

The other constituents of the gas were normally about as follows: SO_2, 8 to 9%; CO_2, 6 to 7%; CO, 0.8 to 1.0%; N, about 84%. It was necessary to admit air to this gas in sufficient amount to allow the acid-making reactions to take place and to give some excess-oxygen in the exit gas. Several different methods and proportions were tried. It was a case of being between the devil and the deep sea. If normal oxygen were maintained—that is, 4 to 6%—in the exit gas, so much air would have to be admitted that the SO_2 tenor of the gas entering would be very low. After trying many different ideas, the Ducktown company decided that the best results were attained by blowing in air at several points in the system. This was done with low-pressure blowers, and the control of the air volume was positive and close. This method is much better than simply allowing flues under suction to draw in air, for drafts always vary from time to time and good control is not certain. The first air was blown in at the flue between the furnace and the Glover tower, and an oxygen content of 3% was aimed at. Each chamber was fitted with air pipes and valves, and the valves were so manipulated as to maintain from 3 to 4% oxygen throughout the system at any given point. Below 3% oxygen, the vigor of the reactions fell off, and the niter recovery in the Gay-Lussacs decreased. This scheme of introducing air at various points as the oxygen is consumed was devised by N. L. Heinz, the company's consulting engineer. While this arrangement was the best one discovered, there was never the same vigorous reaction in the front of the system as that which took place with gas having the usual SO_2 and oxygen percentages.

CO_2 Gas Makes Process Sluggish

The effect of the CO_2 was certainly bad, but not in the exact way that had been looked for. Many times for days together the CO_2 percentage equaled or even exceeded that of the SO_2. This occurred when the furnace condition demanded more coke than usual or when the grade of matte became too low; that is, when the sulphur elimination fell off. As to segregation of the CO_2, we were never able to establish any such thing in the chambers. Many tests at different levels and in corners, etc., failed to show CO_2 consistently higher in any parts of the same chamber. The general effect of CO_2 is simply to slow down the reactions and make the process sluggish. It is difficult with high CO_2 to oxidize the last one or two tenths of a per cent of SO_2, and in order to get a reasonable production, a little SO_2 must be allowed to go to the Gay-Lussacs. This of course makes niter loss abnormal. To compensate to some extent for the deadening effect of the CO_2, a very large niter circulation was maintained, and this also tended to make the Gay-Lussac loss more than normal.

The irregularities of the gas quality and quantity were found to be quite as serious as the CO_2 feature. It is to be expected that blast-furnace gas would be irregular, because of the necessity of frequent opening to charge, to bar down crusts, and to perform many other necessary operations. Changes in the composition of the ore, or irregularities in weighing influence the gas immediately. We were able, by means of the air-blower system previously mentioned, to take care of some of the variations. When, however, the relation of the CO_2 to SO_2 changed considerably, very little could be done except at the furnace. Operating the furnace for gas as well as matte becomes a matter requiring much more skill and attention than when matte alone is the aim.

The problem of exclusion of false air at the furnace top always gave trouble and always will. It is very difficult if not impossible to make tight the top of a copper blast furnace as now constructed. When the acid plants were built, the Tennessee Copper Co. was using the conventional side-charging method employing vertical

sliding doors. The Ducktown company had an unusual arrangement. Instead of the ordinary brick and steel superstructure with steel flue downtake, the gas was taken off at one side of the furnace below the charge-floor level. The furnace was covered by a flat top made up of water jackets, which was hung from trucks. These ran on a track laid in water beams resting on the tops of the side jackets of the furnace. A charge car electrically driven, ran on the same track, which extended back under the charge bins. The essential feature of this charge car was an endless belt made up of lapping steel plates and driven by a motor. To operate this arrangement, the car ran under the bins and the charge was drawn down onto the belt. The car then advanced over the furnace, pushing ahead of it the furnace top. By moving the belt forward, the charge was dumped and distributed as the operator desired.

It soon developed that the acid plants got better gas and could control the process more closely when the flues were so dampered as to create some slight back pressure at the furnace tops. The ideal condition for operating both furnnace and acid plant was to have neither pressure nor suction at that point. This was aimed at, but the way it worked out was that the acid plant maintained some back pressure. This made conditions on the charge floor bad, and the hot gas was very hard on the structure.

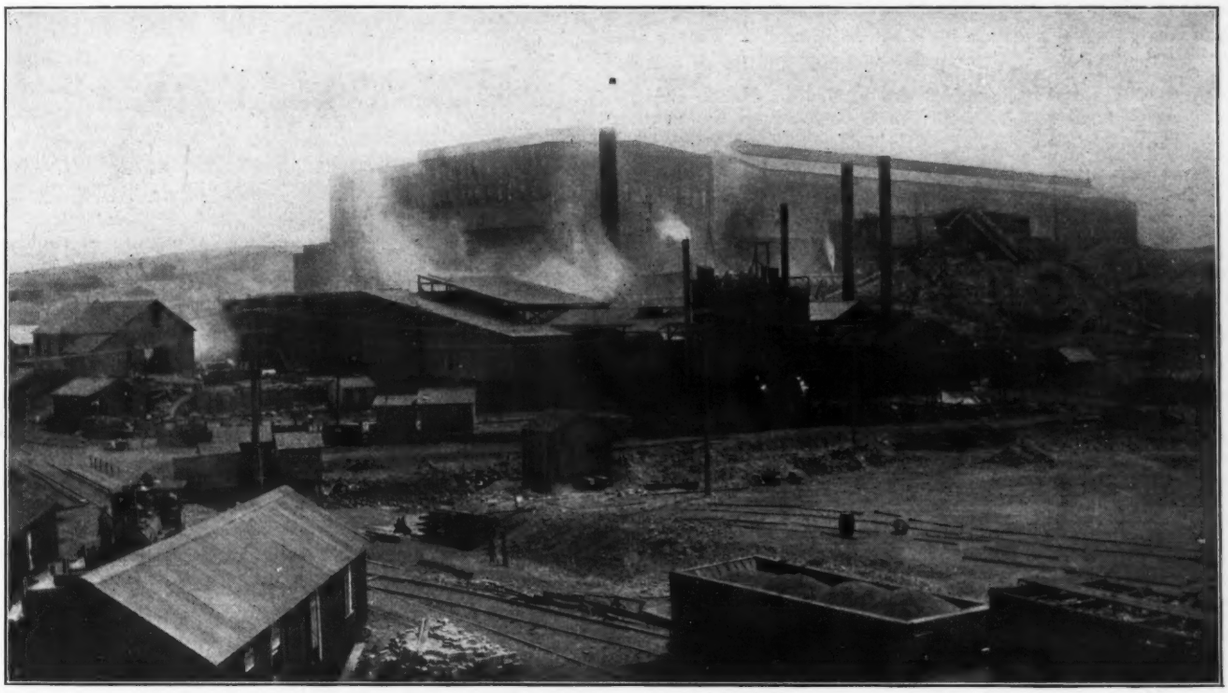
N. H. Emmons, in the *Journal, of* Mar. 18, 1911, described the experience of the Tennessee Copper Co. with furnace tops. At that time he considered best a top similar to the usual design, but with cast iron instead of steel for the posts and dividers and with inward-opening doors operated by an ordinary railroad switch stand. This article shows by photograph the destructive effects of the hot gas blowing back upon the structural-steel parts of the original top. If any changes in top design have been made there I do not know.

The Ducktown company found its top and charging arrangement to work very well. One improvement was made, however. The original top had no means for raising or lowering, but an inch or two of clearance was left between the lower face of the top and the edge of the water beam. Later, the top was altered to raise and lower by the use of four air cylinders. Just before the charge car arrived each time, the top was raised about four inches, and when charging was completed, it was lowered to seat on the edge of the beam. This made a practically tight top so long as it was kept in good adjustment. W. H. Freeland, former manager of the Ducktown company, devised this top and charging arrangement.

High vs. Low Chamber Construction

The acid systems themselves at the two plants differed greatly. The original Tennessee plant consisted of 12 Falding high chambers, 50x50 ft. by 70 ft. high. The idea with this type of chamber was to have each one accomplish the complete process in itself. The gas mixture was admitted at the top, and as the SO_2 was oxidized and the vigor of the reaction became less and generated less heat, that gas would sink and finally be drawn off at a point near the bottom. The gas movement was originally intended to be accomplished by the pull of the 325-ft. smeltery stack and by steam jets in the connecting flues acting as aspirators. The plant was never very successful while working along these lines, and it was later altered. The chambers were connected in series, fans were added, and the work was much improved.

The results obtained from high chambers are apparently neither better nor worse than those from chambers whose long dimension is horizontal. It certainly saves ground space to have chambers 70 ft. high instead of 30 ft. or less. It also introduces some structural problems.



ACID PLANT OF DUCKTOWN SULPHUR, COPPER AND IRON CO., ISABELLA, TENN.

Unless ground space is limited, it is probably better to build the vertical dimension not over 30 to 40 ft., on account of the difficulties of building maintenance, and of operating high structures.

The Ducktown company's plant was built more along conventional lines; that is, the chambers were about 24x30 ft. by 96 ft. long and were connected eight in a set. Special flue connections between them were designed to thoroughly mix and cool the gases and to prevent segregation of the CO_2. They were quite effective in this, but were rather expensive to build and difficult to repair.

Both plants found it economical to provide unusual Gay-Lussac space on account of the large niter circulation and the sluggish process. Whereas in the usual plant Gay-Lussac volume equal to from 2 to 3% of the chamber space is sufficient to give 85 to 90% niter recovery, the Tennessee and Ducktown plants both had near 6% and had even then, high losses.

No Charge for Sulphur Results in Low Costs

The cost of making acid at these plants was low because there was no charge for sulphur, which ordinarily amounts to about $3 per ton of 60° acid. Niter cost, as mentioned, was high. Whereas many plants run with from 3 to 4% niter and some under 3%, these plants on blast-furnace gas used from 6 to 8%. This means, with niter at $50 a ton, that the ordinary cost per ton of acid for niter is 40 to 50c., while the Tennessee plants were doing well under $1 per ton.

Labor in the South is cheap, so that actual labor cost was low. The number of men required, however, was large owing to the irregularity of the process and to the dirty gas, which made an unusual amount of flue cleaning and tank washing necessary. It should also be said that the irregularities of gas supply, together with frequent complete stops, also the high niter circulation, were very hard on the lead, so that the life of these plants will be shorter than normal, and repair costs high.

The Tennessee Copper Co. operated its acid plant on a mixture of gas from several furnaces. Some doubt was expressed at first as to whether successful operating could be done with only one furnace. The Ducktown company, however, showed that very good work could be done with one furnace alone; in fact, the customary practice there is to run only one.

Anaconda Low Pressure Complications

The acid unit at Anaconda was described by Mr. Mathewson in the *Journal* of Apr. 24, 1915. Its purpose was to supply acid for leaching and flotation. The gas is derived from fine jig concentrates from the mill, which carry 35% S and 7% Cu. This material is roasted to about 7% S, which is the grade of calcine desired by the reverberatories. Except for the fact that the ground for a large acid plant was not available within the smeltery site at Anaconda, the plant would have used gas from the regular roasting plant. Because it was necessary to place the acid plant a mile away, separate roasting furnaces were installed for the particular purpose of making acid. The roasting operation is as truly a part of the copper recovery, however, as if it were done at the regular roasting plant.

There is nothing unusual about the acid system at Anaconda. It is well constructed, all the buildings being of brick, and is of very pleasing appearance. Exceptionally large chambers are used, 40 ft. wide, 36 ft. high and 96 ft. long. There were originally six of these in series, and later two were added. As this 36x40-ft. section gives a low ratio of radiation surface to volume, 29 small circular chambers of 11 ft. diameter by 36 ft. high were introduced among the main chambers to effect cooling and mixing. Two 8-ft. hard-lead fans move the gases.

There is one distinct disadvantage that the Anaconda plant is under. This is the altitude, 5,300 ft. above sea level, with a normal barometer of 622 mm. In the operation of a gas process this matter is of importance. It means in this particular case that 1.25 cu.ft. of SO_2 must be handled to get the same weight of acid that the sea-level plant gets with 1 cu.ft. Also with the reduced pressures all the reactions are lower and the absorption of the N_2O_3 in the Gay-Lussacs is not so active. By allowing chamber space in about the ratio of the barometric pressure to sea-level barometric pressure, something over the rated capacity has been produced, with normal niter consumption; that is, about 3.5% on the sulphur. This has been accomplished without unusual Gay-Lussac space, the ratio being about 3% of the chamber volume.

One feature of the roasting operation which causes it to lack the simplicity of straight pyrites roasting, is the high copper content—about 7%. This lowers the fusing point of the ore, and on the second and third floors tends to matte and stick to brick and rabbles with the trouble always attendant. This is not serious, but accounts for some daily cutting and renewing of rabbles.

At the Garfield plant, near Salt Lake, a chamber-acid unit is nearing completion.[1] This plant will use mainly gases from McDougall-type roasters burning fines. A novel feature of this plant will be the passing of the roaster gas through contact masses of lump ferric oxide obtained by burning lump pyrites in conventional lump burners. A considerable conversion of SO_2 to SO_3 is expected by this arrangement before the gas enters the Glover tower.

Contact and Chamber Processes Contrasted

The plants described, excepting the Garfield unit, are all straight chamber processes. The Garfield is a combination of contact and chamber, but probably does not rely on the contact for more than 25% conversion. The fact that all these are chamber plants does not mean that nobody has considered or tried applying the contact processes to metallurgical gases. The contact processes always appear attractive because the plants look small and cheap to build and no high-priced niter is consumed in their operation. But even the owners of the contact processes concede that for making low-strength acid where purity is not essential, the chamber process is considerably cheaper.

Without going greatly into detail, it will suffice to give two or three general reasons for this. The great essential of successful contact work is absolutely clean gas and dry gas. Dust or even a most minute amount of arsenic is highly injurious to a platinum-contact mass. Moisture is as bad on a ferric-oxide mass. Metallurgical gases are always dirty and usually wet. If they be thoroughly cleaned, they must be cooled to a considerable extent. If cooled, they must be reheated to contact

[1]Since this article was written this plant has begun operations.—Editor.

temperature, 400 to 650° C., which means the consumption of fuel. Use of the contact processes means payment of royalties. Operating costs are higher than with the chamber process, and this soon wipes out the advantage of lower capital expenditure.

The chamber process will make 60° acid at a metallurgical plant, nothing being charged for sulphur, for from $2 to $3 per ton, depending on conditions and methods of bookkeeping. A well-constructed chamber plant in normal times costs from $3,000 to $4,000 per ton of daily capacity to build.

The plants described have used roaster or blast-furnace gases. About a copper-reduction works one other possible source of suitable SO_2 exists; namely, the converters. Reverberatories will not do, of course, as the sulphur elimination is slight and the gas low in SO_2. One would expect very high SO_2 gas from converters, and actual tests show percentages approaching 20 at certain stages of the blow. The operation is intermittent, of course, and to run a chamber process on the gas delivered, it would be necessary to have several converter units discharging into a large common flue. Dampers for closing the hoods while skimming and pouring would be required, and in general all possible means for excluding false air. If the Ducktown company has been able to operate successfully on a single blast furnace, producing CO_2 as high as SO_2, operation with a battery of converters delivering 10 to 20% SO_2 should not be impossible.

Minerals Separation Ltd., vs. James M. Hyde

In the report of the decision of the United States Supreme Court in the case of Minerals Separation, Ltd., vs. James M. Hyde, made in the *Journal* of Dec. 16, there were some minor points that need correction. First, the court did not sustain the Minerals Separation patent under consideration as to claim No. 4, but otherwise the claims sustained were as stated.

On page 1069, line 39, the word "impossible" should be replaced by the word "clear." On the same page, line 55, the word "Air" should read, "Ore." The official version of the decision makes no further changes in the text as published.

Alaska License-Tax Law Valid

By A. L. H. Street*

The law enacted by the Alaska legislature in 1913 imposing a license tax on the business of mining of 0.5% on all net incomes above $5,000 per annum, was lately upheld by the United States Circuit Court of Appeals, Ninth Circuit, against an attack upon its validity. (Alaska Mexican Gold Mining Co. vs. Territory of Alaska, 236 Federal Reporter, 64). The court says:

The tax being one which could be lawfully imposed, we believe it beyond judicial power to declare the law imposing it to be invalid merely because the legislature laid down a procedure which, if literally obeyed in the arrangement of the steps required, necessarily would defeat the plain, expressed object of the legislation. The intention being plain, the inartificiality of the law should not result in its overthrow.

Other points decided in the same opinion are that one who has never applied for a license under the law has no standing in court to attack the validity of the law on the grounds that its provisions render the granting of a license an arbitrary power; and that, since the law is not a pure revenue measure, it is not invalid under the provision of the Alaska Organic Act, requiring uniformity of taxation.

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Co-Operation in Export Trade

Legislation now pending in Congress for the purpose of clarifying the antitrust laws in so far as export trade is concerned is of great importance to the copper-producing industry. Indeed, it is scarcely too much to say that the copper producers, under the leadership of John D. Ryan, whose arguments have been extraordinarily lucid and impressive, have had more to do with getting consideration for this movement than anybody else. It is held by good lawyers that the Sherman law does not, anyway, apply to foreign trade, but it is considered desirable that Congress shall make this quite clear.

The Federal Trade Commission in its last annual report expressed itself on this subject as follows:

Among the first questions to which the commission directed its attention was one which it was specifically authorized to investigate under its organic act (Sec. 6, Par. h); namely, "trade conditions in and with foreign countries where associations, combinations or practices of manufacturers, merchants or traders, or other conditions, may affect the foreign trade of the United States." The commission was directed, moreover, "to report to Congress thereon with such recommendations as it deems advisable."

The scope and character of this investigation has been described above. The commission, as a result of its investigation, found that, while there were various conditions which affected the successful development of export trade, there was one factor which was peculiarly within its jurisdiction; namely, coöperative organization of American exporters for the purpose of efficiently conducting their trade in foreign markets. The commission found that American exporters were at a disadvantage compared with their rivals in the chief foreign exporting countries, where combinations for the export trade are effectively developed.

Furthermore, it was found that doubt and fear as to legal restrictions prevented American exporters from developing equally effective organizations for overseas business and that the foreign trade of our manufacturers and producers, particularly the smaller concerns, suffered in consequence. The commission recommended, therefore, that declaratory and permissive legislation be enacted by Congress to make it clear that such organizations are lawful. The chief conclusions of the commission, as stated in the summary of this report, were as follows:

PREVENT DANGER OF MISUSE OF COÖPERATIVE EXPORT ORGANIZATIONS

Two chief dangers from coöperative export organizations of American manufacturers and producers are apparent. They may be used to exploit the home market, and they may be used unfairly against individual American exporters in foreign trade. The dangers in coöperative action must be faced frankly and provided against fully.

The commission is confident that this can be done without sacrificing the essential advantages of joint action and without altering the policy of the antitrust laws or interfering with their enforcement. Thus specific extension of the law prohibiting unfair methods of competition to export trade and requirement of full reports to the Federal Trade Commission from coöperative export organizations will protect the individual exporter, while the enforcement of the antitrust laws will prevent the use of such organizations to effect restraint of trade or monopoly in the domestic market.

The commission does not believe that Congress intended by the antitrust laws to prevent Americans from coöperating in export trade for the purpose of competing effectively with foreigners, where such coöperation does not restrain trade within the United States and where no attempt is made to hinder American competitors from securing their due share of the trade. It is not reasonable to suppose that Congress meant to obstruct the development of our foreign commerce by forbidding the use, in export trade, of methods of organization which do not operate to the prejudice of the American public, are lawful in the countries where the trade is to be

carried on, and are necessary if Americans are to meet competitors there on equal terms.

DECLARATORY LEGISLATION RECOMMENDED

By this investigation the commission, however, has established the fact that doubt as to the application of the antitrust laws to export trade now prevents concerted action by American business men in export trade, even among producers of noncompeting goods. In view of this fact and of the conviction that coöperation should be encouraged in export trade among competitors as well as noncompetitors, the commission respectfully recommends the enactment of declaratory and permissive legislation to remove this doubt.

The commission feels that it would fail of its duty if it did not urge the pressing need of such action immediately. If American business men are to make the most of the great opportunities now before them, are to build securely in foreign trade and are to avoid disaster in the shock of the stern and determined competition that will doubtless follow the war, they must at once perfect the organization demanded by the conditions of international trade.

This recommendation of the commission was given consideration by the Committee on the Judiciary of the House of Representatives, which reported a bill (H. R. 17,350), commonly known as the Webb bill (see Exhibit 5), embodying the principles recommended by the commission. This bill was passed by the House near the close of the last session, but there was not sufficient time left for its consideration by the Senate.

Particular attention, however, is called to the fact that though the bill as originally reported to the House appears, in the opinion of the commission, to effectively meet the purpose for which it was drafted, yet, on the other hand, two amendments were made to the bill during the debate which seem to give a basis for legal construction that might entirely nullify this purpose.

The first amendment referred to was made in the first section of the bill. In order to permit coöperation only with respect to export trade, the term "export trade" was originally carefully defined to exclude the production or manufacture of goods within the United States, but the amendment made it also exclude "trading in or marketing" such goods within the United States. (See Exhibit 5.) Obviously a successful coöperative export organization would, in most cases, be obliged to purchase goods in the United States and therefore to trade in them.

The second amendment referred to is found in the second section. This originally granted the right of coöperative association for export trade, provided such association did not involve "restraint of trade within the United States." But the amendment added a further proviso; namely, "and does not restrain the export trade of the United States." (See Exhibit 5.) The commission is of the opinion that these provisions of the bill would not change the present law. But the very purpose of the bill was to clarify the law, while this amendment presents the same question of construction as the existing law. The law, therefore, would be neither changed nor clarified if the bill were enacted in the form in which it was passed by the House. Therefore the business man who is deterred from engaging in coöperative action in export trade by fear or doubt concerning antitrust laws would be left in exactly the same position as before.

Exhibit 5—the Webb bill—is as follows:

AN ACT TO PROMOTE EXPORT TRADE, AND FOR OTHER PURPOSES

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the words "export trade" wherever used in this Act mean solely trade or commerce in goods, wares or merchandise exported, or in the course of being exported from the United States or any Territory thereof to any foreign nation; but the words "export trade" shall not be deemed to include the production, manufacture, trading in or marketing within the United States or any Territory thereof of such goods, wares or merchandise, or any act in the course of such production or manufacture.

That the words "trade within the United States" wherever used in this Act mean trade or commerce among the several states or in any territory of the United States, or of the District of Columbia, or between any such Territory and another, or between any such Territory or Territories and any State or States or the District of Columbia, or between the District of Columbia and any State or States.

That the word "association" wherever used in this Act means any corporation or combination, by contract or otherwise, of two or more persons, partnerships, or corporations.

Sec. 2. That nothing contained in the Act entitled "An Act to protect trade and commerce against unlawful restraints and monopolies," approved July second, eighteen hundred and ninety, shall be construed as declaring to be illegal an association entered into for the sole purpose of engaging in export trade and actually engaged solely in such export trade, or an agreement made or act done in the course of export trade by such association, provided such association, agreement, or act is not in restraint of trade within the United States, and does not restrain the export trade of the United States.

Sec. 3. That nothing contained in section seven of the Act entitled "An Act to supplement existing laws against unlawful restraints and monopolies, and for other purposes," approved October fifteenth, nineteen hundred and fourteen, shall be construed to forbid the acquisition or ownership by any corporation of the whole or any part of the stock or other capital of any corporation organized solely for the purpose of engaging in export trade, and actually engaged solely in such export trade, unless the effect of such acquisition or ownership may be to restrain trade or substantially lessen competition within the United States.

Sec. 4. That the prohibition against "unfair methods of competition" and the remedies provided for enforcing said prohibition contained in the Act entitled "An Act to create a Federal Trade Commission, to define its powers and duties, and for other purposes," approved September twenty-sixth, nineteen hundred and fourteen, shall be construed as extending to unfair methods of competition used in export trade against competitors engaged in export trade, even though the acts constituting such unfair methods are done without the territorial jurisdiction of the United States.

Sec. 5. That every association now engaged solely in export trade, within sixty days after the passage of this Act, and every association entered into hereafter which engages solely in export trade, within thirty days after its creation, shall file with the Federal Trade Commission a verified written statement setting forth the location of its offices or places of business and the names and addresses of all its officers and of all its stockholders or members, and if a corporation, a copy of its certificate or articles of incorporation and by-laws, and if unincorporated, a copy of its articles or contract of association, and on the first day of January of each year thereafter it shall make a like statement of the location of its offices or places of business and the names and addresses of all its officers and of all its stockholders or members and of all amendments to and changes in its articles or certificates of incorporation or in its articles or contracts of association and of all contracts, agreements, and understandings had with any foreign or domestic association in regard to the conduct of or practices in foreign trade. Any association which shall fail so to do shall not have the benefit of the provisions of section two and section three of this Act, and it shall also forfeit to the United States the sum of $100 for each and every day of the continuance of such failure, which forfeiture shall be payable into the Treasury of the United States, and shall be recoverable in a civil suit in the name of the United States brought in the district where the association has its principal office, or in any district in which it shall do business. It shall be the duty of the various district attorneys, under the direction of the Attorney General of the United States, to prosecute for the recovery of the forfeiture. The costs and expenses of such prosecution shall be paid out of the appropriation for the expenses of the courts of the United States.

Passed the House of Representatives September 2, 1916.

In his last message to Congress the President of the United States urged the enactment of this legislation.

Liens Against Nevada Mining Property

The Nevada Lien Law provides that an owner of property may avoid attachment of a lien against it on account of an improvement made by a lessee, by posting in some conspicuous place on the property a written notice that he will not be responsible. Under this statue the Nevada Supreme Court holds in the case of Phillips vs. Snowden Placer Co., 160 Pacific Reporter, 786, that an owner of mining property did not avoid liability to a lien by posting a notice at the collar of a mine shaft which he knew would be destroyed before entry upon work by the lien claimants. The notice must be so posted that under ordinary conditions it will remain in place for a reasonable length of time.

The Wave-Transmission System and Its Use in Drilling

By E. M. Weston*

SYNOPSIS—The invention of a sixth method of power transmission is described. This has been recently patented in England and promises to reduce greatly transmission and plant costs. Its application to rock drilling is described. Power is transmitted by means of alternate compressions and expansions in a system of pipes filled with water.

The wave-transmission system is claimed to be a new and revolutionary method of transmitting power in variable amounts over variable distances with efficiencies in small installations greater than that of electricity and in all cases equal efficiency at a smaller cost of installation. These are big claims for a new invention; but I believe that this system has an enormous field of usefulness and that the invention is of importance equal to or greater than those of wireless telegraphy and electrical transmission of power.

What is wave transmission? Wave transmission depends for its possibility on the fact that water is compressible and elastic. It is popularly supposed that water is incompressible, but it is really very many times more compressible than steel. Water is compressed about 0.000046 for every atmosphere. It will easily be shown by a simple calculation that in a pipe only one inch diameter, 600 ft. long with a pressure of 1,000 lb., the compression of water amounts to many cubic inches.

Now let us imagine a pipe completely filled with water, having a plunger at one end fitting in it and a similar plunger at the other end. If, by means of any prime mover the plunger is made to reciprocate, alternate waves of compresion and rarefaction are set up, which travel along the pipe. These waves travel at the same rate as sound travels in water, about 4,800 ft. per sec. The length of the wave is this distance divided by the frequency, or the number of pulsations per second. It is obvious that at the other end of the pipe a similar piston will reciprocate in sympathy with the plunger of the prime mover. The prime factor is the mean pressure times the mean flow. Angle of phase and flow and influence when in place produce work, otherwise they are mutually destructive.

The power-transmission pipe is first completely filled with water at a pressure of 100 lb. per sq.in. The plunger has an auxiliary pump attached for making up any loss by leakage. The pressures producing waves may be anything from 500 lb. upward; for rock drills 1,000 lb. will be employed. Now it is obvious that, if in a simple pipe line supplying power to a distant plunger, the plunger is stopped, the waves will rebound and "resonance" will be set up; otherwise the pipe will be subjected to such stresses that it will burst. The inventor discovered, however, that if a vessel of a certain cubic capacity in relation to the displacement of the piston plunger and completely filled also with water were attached to the pipe line, the vibrations would be absorbed and the only result of turning off one or all of the machines worked from the pipe line would be to return some or all of the energy generated in waves to the plunger (or the rebound as it were); so that the work taken from the prime mover is always proportional to the work being delivered. The losses of power in friction in the pipe line are small because this system differs entirely from hydraulic systems, as there is no flow or transference of water along the pipe line. As before stated, these losses compare favorably with those of electrical transmission.

If it is necessary to take off branch pipes to work tools along the main pipe lines, these in ordinary course could be taken only if at certain points along the wave lengths; but by inserting a "condenser," which is nothing but a plunger of certain weight with a spring at each end reciprocating in the pipe, the wave length can be changed and power branch lines can be taken off at any point.

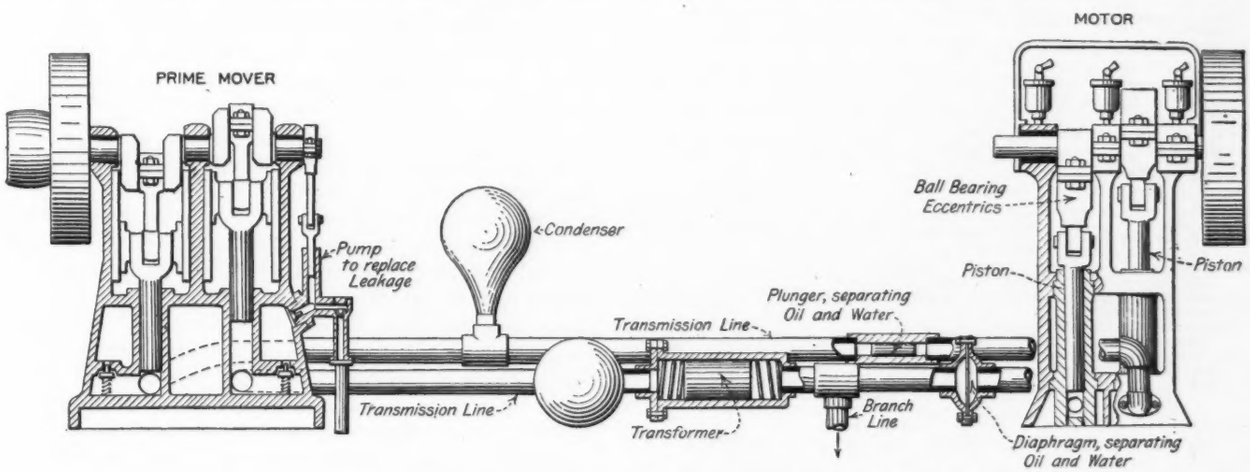


FIG. 1. TWO-PHASE TRANSMISSION LINE FOR ROTARY MOTOR OPERATION

*The Randfontein Central Gold Mining Co., Millsite, Transvaal, South Africa.

Water is the liquid most suitable for general work in pipe lines for wave transmission, but an important advantage is gained by the fact that, by introducing a flexible diaphragm or a plunger, the working portions of tools or motors can be filled with oil, causing perfect lubrication and transmitting the power waves with equal facility. Fig. 1 is an illustration of a two-phase transmission for working a rotary motor and shows the essential parts of the system.

From both the scientific and practical points of view one of the most interesting facts about wave transmission is its similarity in many features to electrical transmission. The points of resemblance are not mere coincidences, but go to prove an important fact; namely, that this purely physical method of transmitting energy is clearly allied and is for all practical purposes a sister method to electricity, more particularly to the alternating-current system. Anyone with a knowledge of electricity will find it easy to understand wave transmission.

Analogy of Wave and Electrical Transmission

The laws and formulas of wave and of electrical transmission coincide to the extent that they are nearly interchangeable. Most of the phenomena of electricity have been parallel to wave transmission. The accompanying table shows this resemblance.

ELECTRICAL EQUIVALENTS TO WAVE TRANSMISSION

Alternating current	Alternating pressure and flow of liquid caused by plunger of generator
Volts	Pressure
Amperes	Flow
Power factor	The customary electrical formula and not the hydraulic one Mean pressure × mean flow × cos. of angle of phase Flow and pressure when in pnase give work when otherwise are mutually destructive
Inductance	Weight or inertia (in regard to condensor effect)
Capacity	Elasticity of fluid medium
Resistance	Volume capacity in proportional to press and flow
Condenser	Elasticity proportional to inertia
Transformer	Differential piston
Generator	Generator
Motor	Motor
Wires or line	Liquid column in pipes
Resonance and surge	Exact equivalent, but controlled absolutely by simpler apparatus
Single-phase or polyphase system Synchronous or asynchronous motors Rotary or reciprocating motors	Each has its exact counterpart in the wave system
Conversion of energy into heat directly by friction	By passing current. That is, liquid of any given flow and pressure through a smaller section of piping the pressure and velocity increase in proportion and both skin friction and molecular friction occur and are dissipated in heat

It will be noted that either reciprocal or rotary motion may be produced at the end of a wave-transmission line. For reciprocal motion either two or three pipe lines are usually employed; but by shortening the wave length and number of plungers, these could be made to work in a way to produce rotary motion. That means that a satisfactory motor (equivalent to driving a motor by single-phase alternating current) can be constructed exempt from many of the drawbacks of such an electric motor.

Theoretically, equally high efficiencies are obtained in electrical and wave systems of transmission. In commercial electrical practice, however, it is well known that considerations of capital cost induce the adoption of efficiencies well below the theoretical. In general industrial practice the lower initial cost of appliances of wave transmission is expected to result in obtaining either the same efficiencies as in electricity at a lower initial cost, or obviously higher efficiencies at the same cost.

The field of application is broad, as there are at present five methods in commercial use for the transmission of power. These are steam, direct mechanical, electric, compressed air, and hydraulic, the last being comparable to direct-current electricity, as wave transmission is to alternating current. Each of these has its field. Some fields are, however, very inefficiently occupied, and the advantages and defects of each system for any particular work are well known and need not be repeated. Wave transmission as a system of power transmission possesses the following advantages: It is simple—any ordinary mechanic can install and keep in order these few moving parts; it is adaptable—it can efficiently perform much that any of the other systems are capable of; it is portable—a 10-hp. generator could be lifted by a man.

Breadth of Application of the System

The initial cost of installation is naturally very low as no expensive copper lines or insulators are necessary. The maintenance charges are low because there are no cranks or couplings in the motors and the chief item would be attention to the packing of the plungers and maintenance of pipe lines.

For mining, its high efficiency and the absence of any danger from fire make it a competitor of electricity—in coal mining for coal cutters, drills, pumps, hoists and conveyors. In metal mines the wave-transmission rock drill promises to compete with the air-driven rock drill to make one source of power apply to all underground mechanical appliances.

In mechanical shops it is already being used for riveters and calkers and has a field in shearing, stamping, hammering and pile driving and for portable stone chippers and metal punchers. In workshops and factories it offers important advantages in running various tools from their own motors, dispensing with overhead shafting and belting.

In pumping, a very simple pump can be designed for all conditions of work—one that will run submerged and be very light. Experiments have also been made showing that it is probable that the ideal method of gear reduction for rail cars, motor cars and, above all, steamships of the largest power has been found. Railway signaling and submarine work also appear promising fields of application. One of the most striking experiments in connection with wave transmission is the production of boiling water by friction in small tubes at the end of a long cold-water column. This can be applied for heating houses and factories most economically. It is being employed for submarine signaling.

Wave transmission was discovered by George Constantinesco, a Roumanian engineer. The system was worked out mathematically, and patents were applied for before a single demonstration had been made, and working models were first made for the patent authorities.

The diameter of the piping in the transmission line is determined by the pressure adopted and the power to be transmitted. The greater the pressure in the liquid column the smaller may be the diameter of piping. In experimenting with a line 50 ft. in length with right-angle bends it was found that 1-in. diameter wrought-iron pipe of ordinary good steam quality would convey 10 hp. with high efficiency. Hydraulic piping and increased pressure will, however, increase this figure 300 or 400%. For many applications steam piping can be used, but hydraulic piping will no doubt be most largely employed. The practical engineer will at once ask what effect the vibration set up will have on the pipe line and whether the

power can be transmitted without too great a loss when the pipes are much bent, as they would be when used in mining. It is stated that experiments have shown that only a very ordinary amount of bracing is necessary to steady the pipes, and the vibration does not seem likely to cause trouble with perfectly designed joints. The system has been in use in engineering shops for some months. The effect of the bends does not appear to be serious, and the power is readily transmitted through a flexible hose to a rock drill. The water used in such a system must of course be free from grit and acid.

Its Application to Rock Drilling

The Haddon drill (Fig. 2) is the first attempt to apply wave transmission to drilling. It is evident that a system that produces reciprocal motion directly and in which the frequency of the blows can be increased up to any limit desired has great possibilities in drilling rock used in either a hammer or a piston-drill machine.

The Haddon drill (Fig. 2) is a piston machine and is in outward appearance similar to an air-operated drill except that there is no valve and no valve chamber is apparent. It consists of a piston mounted between a rear and a front bearing and "floating" between a strong spring on the front and a weaker one on the back. The rear of the piston is cut for the ratchet and enters a rear chamber containing pawl and ratchet for giving rotations. This chamber is full of water connected with the power line by a hose. The wave of compression sweeps into this chamber and forces out the piston against the spring, which brings it back on the return stroke, which is governed by the rear spring.

The drill has few moving parts. The introduction of springs has been criticized but it would be easy to arrange the return stroke by wave motion. Tests, however, show that satisfactory springs having a long life can be procured, and they are easily changed if necessary. The length of stroke is controlled by opening or closing the cock, but apart from the momentum of the piston and tool being decreased by the shorter stroke, the strength of the blow remains the same. This allows holes to be rapidly collared on a very short stroke.

A positive mechanical revolution is being introduced into later designs of the drill, brought about by an auxiliary piston panel acting as a floating ratchet disk on the piston. This will be an important point in any hammer-drill model.

The following questions naturally suggest themselves to the practical mining engineer: Will not the return stroke of such a drill be weak, causing constant fitchering? It is reported that trials show that fitchering rarely occurs, owing to the constant tugging action due to the repeated blows of the wave motion going on whether the drill be struck or not, and that this is a most marked feature of the drill. With such high pressures will not leakage be excessive? It is said that during lengthy trials leakage is trapped to supply water for the drill, but owing to the design of the drill the bearing which has to resist leakage can be made very long and can be easily replaced by any special hydraulic design that may be found suitable. Personally, I consider that only long underground experience will prove whether this consideration will be vital. It is easy to calculate that a certain percentage of leakage can be allowed without vitally impairing the efficiency of the system. The drill can be used with either solid or hollow steel, and naturally the system lends itself splendidly to the use of hollow steel and water injection. Acid or gritty water must not be employed, or the springs and the interior of the drill must be of some acid-resisting alloy. The latest type of drill is designed to strike 1,000 blows of a force of about 40 to 50 ft.-lb. and weighs only about 180 lb. The original design struck 500 blows a minute and showed itself a rapid driller.

Short-Stroke Piston Drill Preferable to a Hammer Drill

I have long held the opinion and expressed it in my writings that the ideal drill for really hard work is not the hammer drill, but that if a piston drill could be designed to work on a very short stroke and to strike 1,000 blows or more per minute and deliver water under pressure to the drill bit, it would prove the ideal tool. It will be remembered that on certain tests on a 2½-in. torpedo drill in California it was found that the fastest drilling was done with a 2½-in. stroke, running about 930 strokes per minute. It is, however, recognized that hammer drills give more time in changing steel, but with a modern rock-drill chuck this is not vital.

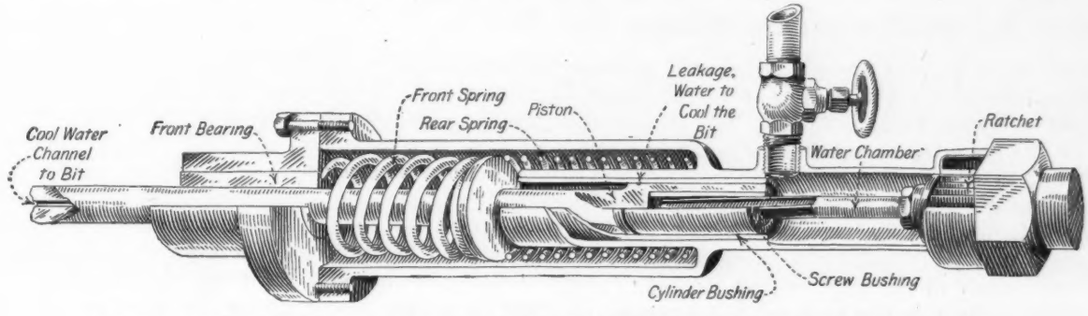


FIG. 2. THE HADDON ROCK DRILL, WHICH IS OPERATED BY WAVE TRANSMISSION

The trials of the first model of the Haddon drill ran for several months near London and were witnessed by numerous engineers. The inventor is convinced that leakage can be easily controlled and claims that while with the compressed-air drill the efficiency is under 10%, the efficiency of a wave-transmission system will be between 60 and 90%; that the cost of installation will be only one-half, the power consumption one-quarter and maintenance charges half, allowing for more expensive hoses and couplings; that there are no valves or delicate parts, and that more powerful and frequent blows can be delivered on a lighter drill with a more flexible stroke. It is estimated that on the Rand, compressed-air power costs $600,000 per annum and drill maintenance $300,000, and of this

about $500,000 might be saved. In July, 1915, there were 9,831 drills on the Rand, 6,410 being in daily use.

If the Haddon rock drill in its piston- or hammer-drill form proves an economic success over a lengthy underground trial, its introduction into mines throughout the world will no doubt take place. It must, however, be remembered that for certain work and in certain situations the exhaust air from the air drill is of priceless value in ventilation and that the expense of providing an adequate alternate system must be charged against any substitute. This matter will no doubt be adjusted, but the merits of the wave-transmission system as applied to mining would be that in any mine a simple power unit (apart from the generation of some electric light) could transmit all its energy into wave transmission and all the work of the mine in stoping, driving ventilation fans, hoisting, pumping, rock drilling and underground haulage could be arranged in the one system. The possibilities of reduction of costs thus shown are enormous, and the fuller economic development of this system, which is of course much hindered by the war, will be watched by all mining engineers with great interest.

One of the leading houses on the Rand has subscribed for and is giving all facilities for an extensive underground test with several machines of different designs. These tests are expected to take place toward the end of the year in one of the large mines of the Rand, and the results obtained will be looked forward to with interest by all mining engineers.

Iron Blast-Furnace Slags

Properties of iron blast-furnace slags and methods employed for calculating the charges (M. A. Pawloff, Rev. Soc. Russe Metal., 1914, 1, 652-79; Rev. Met., 1916, 13, Ext., 50-60) are given as follows by *Jour. Soc. Chem. Ind.,* Nov. 15, 1916:

In calculating the charge of a blast furnace, the relation between the ore, the flux and the fuel-ash must be determined, so that the quantity and composition of the slag may correspond to the kind of iron desired. The amount of slag is kept as low as possible for reasons of economy, and the quality, as determined by the physical properties and chemical composition, is chosen to favor the reduction of the elements desired in the metal, while opposing the passage to the metal of objectionable substances. The fluidity of blast-furnace slags is almost entirely dependent on the relative proportions of (SiO_2 + Al_2O_3) and CaO. Normal slags in charcoal furnaces contain 65 to 60% (SiO_2 + Al_2O_3), and the ratio $\frac{SiO_2 + Al_2O_3}{CaO}$ varies only from 2 to 1.5. When coke is used, the proportion of lime must be increased on account of the sulphur. In these slags the ratio $\frac{SiO_2 + Al_2O_3}{CaO}$ approaches unity corresponding to 40 — 50% (SiO_2 + Al_2O_3), the average content of CaS being 5%. The second important physical property of slags is the heat required for melting. In charcoal furnaces the most fusible slags with a heat of fusion between 340 and 400 cal. per kg. are chosen; in coke furnaces the degree of fusibility is generally within the limits 350 and 460 cal. Diagrams showing the degree of fusibility of slags with varying amounts of lime, alumina and silica are given, with additional lines for the ratios $\frac{SiO_2}{Al_2O_3}$ and $\frac{RO}{SiO_2}$. Slags having different chemical compositions may possess the required fluidity and degree of fusibility, and the composition selected will depend on the kind of iron desired. The proportion of sulphur retained by the slag depends on the proportion of lime (or of CaO + MgO + MnO). Silica does not exceed 38% in the slags of modern coke blast furnaces. Charcoal furnace slags are characterized by a smaller lime content, ore for these furnaces being desulphurized when necessary, by preliminary roasting. The reduction of manganese also depends directly on the proportion of lime and magnesia in the slag, and to prevent the formation of infusible masses in the furnace, lime is often replaced by magnesia. In the manufacture of ferromanganese the slag may contain up to 12% MgO, with 38—36% CaO. The reduction of silica is, on the contrary, prevented by the presence of much lime and magnesia in the slag, and other things being equal, the consumption of fuel required to cause the passage of a certain quantity of silicon into the iron is less as the amount of (SiO_2 + Al_2O_3) in the slag is higher. With charcoal the (SiO_2 + Al_2O_3) may attain 70% of the weight of the slag, but with coke, in view of the necessity of eliminating sulphur, the slag should not contain more than 45 to 50% (SiO_2 + Al_2O_3). Where high temperatures are employed, less lime is needed, as the sulphur is partly volatilized. The reduction of phosphorus is complete when the ratio $\frac{CaO}{SiO_2} = 1.65$. The quantity of slag formed depends on local conditions. With charcoal, a minimum of 25% of the weight of the iron may be attained; with coke, the proportion varies from a minimum of 40% to a maximum of 150%, the latter amount being formed in smelting Cleveland ores. The weight of coke required varies from 80 to 120% of the weight of iron produced and rises to 200 to 250% for ferromanganese and ferrosilicon. The determination of the quantity of flux necessary for slagging the ash of the fuel and the gangue of the ore may be based on four different quantities:

1. The ratio of the oxygen of the silica to that of the base of the slag. This method is only suitable for charcoal furnaces, the ash of the fuel taking no part in the action and the ratio $\frac{SiO_2}{Al_2O_3}$ in the slag being given directly by the analysis of the ore. The most fusible and most acid slag being the most advantageous and the ratio $\frac{SiO_2}{Al_2O_3}$ being known, a suitable degree of acidity may be obtained by reference to the diagrams.

2. The ratio (by weight) $\frac{SiO_2 + Al_2O_3}{RO}$. This ratio, proposed by Platz, is a better basis for calculating the charge than the former ratio. In coke furnaces its value is generally made $\frac{48}{52}$ for cast irons and $\frac{52}{48}$ for irons to be refined. An objection, however, to the use of a constant figure for this ratio is that the properties of slags may vary according to the relative proportions of SiO_2 and Al_2O_3. In charcoal furnaces the ratio $\frac{SiO_2 + Al_2O_3}{RO}$ is generally about $\frac{63}{37}$. It is shown by diagram that

slags with 37% CaO may vary largely as regards Al_2O_3 and SiO_2 without raising the heat of fusion above 360 cal., and with the ratio $\frac{63}{37}$ fusible slags are given for all values of $\frac{SiO_2}{Al_2O_3}$ between 1 and 30.

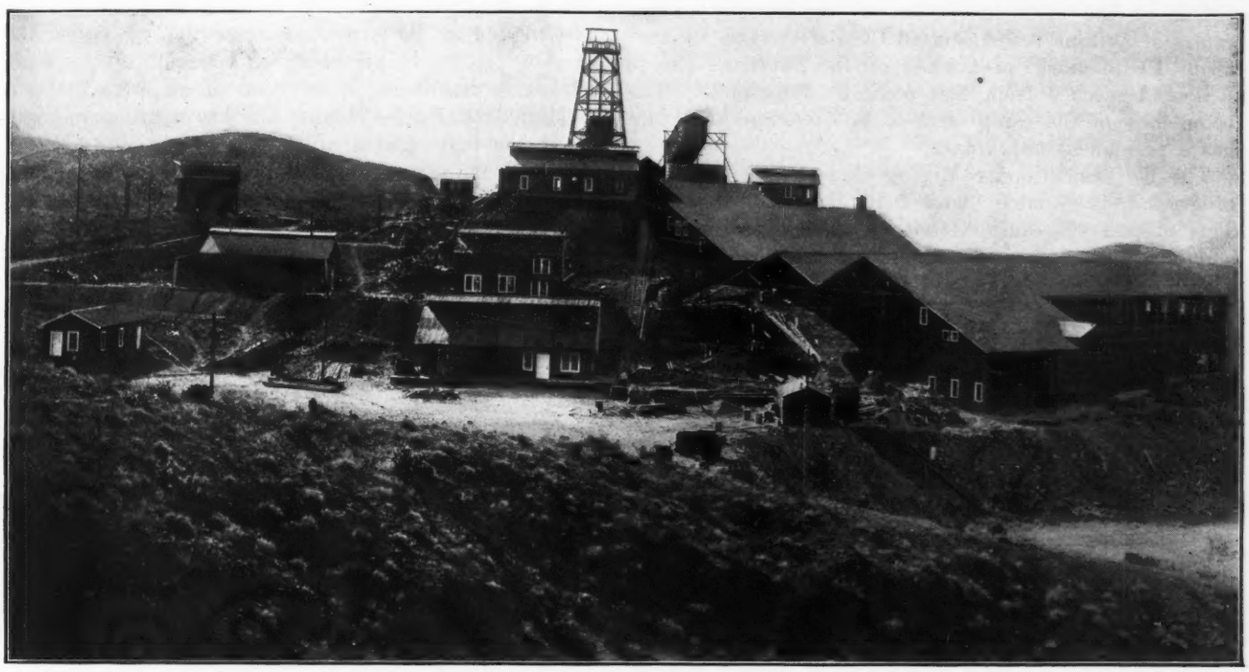
3. The ratio (by weight) $\frac{RO}{SiO_2}$. In this method alumina is considered as neutral. In coke furnaces the ratio varies from 1.65 for the most basic and least fusible slags, to 1.20 for the most fusible slags. The usual value is 1.4 to 1.5. This method is not suitable for calculating the charges of charcoal furnaces.

4. The content in the slag of SiO_2 CaO, (SiO_2 + Al_2O_3), or RO. This method is equally suitable for coke and charcoal furnaces. The most suitable constituent to consider in both cases is (SiO_2 + Al_2O_3).

Oatman Output Will Increase

OATMAN CORRESPONDENCE

The United Eastern's 200-ton cyanide mill[1] is nearly completed at Oatman, Ariz., and is expected to begin operating during the Christmas holidays. This will be followed next summer by an increase in the Tom Reed's milling facilities, and a steady increase in the gold production of the Oatman district during the next few years is expected. The new mill will use the continuous counter-current system of decantation and agitation. Marcy ball mills are used for crushing, and for fine grinding Allis-Chalmers tube mills with balls, the ore being ground to 200-mesh. The crushing-and-grinding department has a capacity of 400 tons, but the thickeners and agitators are designed to treat only 200 tons per day. In places the vein is 40 to 50 ft. wide. A new three-compartment shaft has been sunk to the 665-ft. level and connected with the vein by crosscuts. The shaft is equipped with electric hoist, and sinking has been resumed; the shaft should cut the vein at 950 ft.



UNITED EASTERN NO. 2 SHAFT AND THE NEW 200-TON MILL NOW READY TO BE PUT IN OPERATION AT OATMAN, ARIZ.

At the beginning of the year, only 10 of the 20 stamps of the Tom Reed mine were dropping and development had been practically confined to the Tom Reed and Ben Harrison claims, comprising but 36 of the 432 acres owned by the company. The interior shaft on the Tom Reed claim has been sunk to a depth of 1,400 ft. A drift to the southeast from the main shaft on the Ben Harrison claim developed a large tonnage of mill ore. At the extreme southeast part of the company's property, east and north of the Big Jim, mill ore has been developed on the Black Eagle, Gray Eagle and Aztec claims. The orebody on the Aztec is of good grade and up to 30 ft. between walls. This development is on the 500-ft. level of the Aztec shaft, where ore bins have been built preparatory to hauling the ore extracted to the mill, a mile

[1] "Eng. and Min. Journ.," July 29, 1916.

Reduction of Acids of Selenium

The reduction of selenic acid to selenious acid is by no means an easy reaction to accomplish. Some recent data on the problem are given by de Coninck and Chauvenet, *Ann. Chim Appl.*, Vol. 21, p. 114.

When a mixture of formic acid with a slight excess of colorless selenic acid (sp.gr. 1.4) is heated gradually to boiling, carbon dioxide is disengaged and selenium is precipitated. Malonic and pyruvic acids also reduce selenic acid; acetic and succinic acids do not; boiling with oxalic acid causes only partial reduction. The selenium deposited has a dark reddish-brown color, is amorphous, and practically insoluble in carbon bisulphide; it is apparently identical with that obtained by reducing selenic acid with sulphur doxide.

[The precipitation of selenium from selenic-acid solutions by sulphur dioxide is difficult and uneconomical commercially, although the reduction of selenious compounds by this reagent is easy. Carbon monoxide reduces selenious solutions readily, but the resultant selenium is so finely divided as to be almost unfilterable.—Editor.]

distant, by auto trucks. With these developments in the easterly end of the property, the company decided to increase the capacity of the mill from 175 tons to 350 tons. Supt. E. W. Rabb is now contracting for the machinery and expects to have the new unit completed by July 1, 1917.

The Big Jim Mining Co. is proceeding with plans for a 400-ton cyanide mill which is to be built along the same general lines as the United Eastern. The orebody in the Big Jim has been developed on three levels—the 300, 400 and 500—for a length of 650 ft. and maintains an average width of 30 ft.

The Johnson District, Arizona

By Harry E. Scott*

One of the most prosperous of the smaller copper camps of Arizona is Johnson, in Cochise County, situated about 10 mi. north of Cochise on the Southern Pacific R.R. and reached from that point by automobile. The boom days of the camp seem to be over, and the place has a permanent appearance.

The Keystone Copper Mining Co., owning 310 acres of ground, is situated about 2 mi. south of the town. This property is equipped with a 30-hp. gasoline hoist and a four-drill Ingersoll-Rand air compressor driven by a 28-hp. crude-oil engine. The two-compartment, perpendicular shaft, which is down 550 ft. at the present time, is being sunk with jackhamers. From the 300- to 500-ft. level the shaft is in a low-grade copper ore, while from the latter point to the bottom the ore averages 4½% copper. W. W. Miller is president and general manager; A. Bannow, vice-president; W. J. Truesdale, treasurer; and T. C. Miller, secretary. The general office of the company is at Newton, Kan.

The Cobriza Mining Co., owning 35 claims and adjoining the Keystone on the west, has the following equipment on its property: A 200-hp. oil-fired boiler, a 12-drill steam-driven Ingersoll-Rand compressor, an electric-light plant, a number of small fans for mine ventilation and a gasoline hoist. This property is being worked through an 800-ft. inclined shaft, shipping 150 tons of 4% copper ore daily and employing 100 men. The Goodrich-Lockhart Co. is operating this mine, the work being under the direction of Robert Morrison, superintendent.

*Johnson, Ariz.

The Arizona & Michigan Development Co., west of the Cobriza, owns nine claims, is equipped with a 200-hp. oil-fired boiler and a 12-drill steam-driven compound Sullivan compressor. A second-motion steam hoist does the hoisting from the main shaft, which is down 400 ft. This company is shipping daily about 50 tons of copper ore running over 4% and is employing 60 men. S. French Hoge, of Frankfort, Ky., is president, and E. C. McMahon, of Louisville, Ky. secretary and treasurer. N. T. Trigar, superintendent, has charge of all work.

The Peabody Consolidated Copper Co., owning a large number of claims, is the oldest producer of the district, having been worked over 30 yr. ago, and is said to have produced several million dollars' worth of copper ore. At present 400 tons per month is being shipped, averaging 6% copper. This property is being worked through a 300-ft. inclined shaft, the hoisting being done by a gasoline hoist. Forty men are employed. Isidore Niner, of New York, is president of the company. W. G. Eberhardt has direct supervision of all work.

The Black Prince Mining Co. has a group of claims about one-quarter of a mile east of Johnson, adjoining the Peabody. These are equipped with two 100-hp. coal-fired boilers, a Sullivan compressor, a first-motion Danville hoist and Waugh drills and three Cameron pumps. All work is being carried on through a two-compartment perpendicular shaft 965 ft. deep, this being the deepest shaft in the district. At present this company is cross-cutting on the ninth level to strike the vein, working three shifts and employing 25 men. The officers of the company are: Robert N. Bell, president; Dr. John C. Thompson, vice-president; J. B. Wright, secretary-treasurer. The main office is in Denver. W. C. Bartlett is superintendent at the mine.

TWO ACTIVE PROPERTIES IN THE JOHNSON COPPER DISTRICT, ARIZONA
Shaft of the Peabody Copper Co. on the left. Shaft and hoist of the Keystone Copper Co. on the right

The Johnson Copper Co. is one of the new companies operating in the district. Its main shaft is within the limits of the town, the equipment consisting of a large gasoline hoist, a five-drill belt-driven compressor and jackhamers. One of the drifts on the 750-ft. level has passed through 14 ft. of ore, J. T. Tong is superintendent.

In nearly all parts of the Johnson district a high-grade copper ore is found near the surface, making it attractive to leasers, of which there are many, all of whom are making much better than wages out of shallow shafts and opencuts, as some of the ore runs as high as 30% copper. The ore is a carbonate near the surface, underlain by the usual sulphides at depth.

Seventeen-Million Dollar Tax on Intelligence

Our esteemed contemporary, the *American Machinist,* published the following editorial, Dec. 21, which is so illuminating, on the vital subject of one of our own recent editorials, that we are republishing it in full.

Yes, you have read the title correctly—a *tax,* not a premium. Not on our daily physical necessities, nor on our more or less dispensable luxuries, but on information—the one thing that is essential to the development of the mind. And this is proposed in the Congress of the United States of America in the year A. D. 1916.

The greatness of a nation may be measured by the extent to which it fosters the enlightenment of its citizens. No statesman, even of present-day average caliber, would be foolhardy enough to oppose the public-school system. A stand in favor of restricting the teaching of reading, writing and arithmetic would be unthought of by the most unthinking politician. It would have the deserved effect of terminating his public life as abruptly as a well-aimed hand grenade would blot him out physically.

Yet reading, writing and arithmetic are merely the tools one uses to acquire the further information that is to be of use to himself, to the community and to the state. The three R's never built a railroad, or ran one. Beyond the education given in public schools must come acquirement of the knowledge of how to do things—that is the basis of material prosperity; and the knowledge of how to think—which is the basis of culture. A small percentage of our population obtains this additional knowledge in universities; another small percentage absorbs it from personal experience, but the great majority of us must get it by reading educational books and periodicals.

The more one sees of the limited vision of some present-day politicians the more he admires the wise and far-seeing statesmanship of past generations that led to the unification of our country in ideals and ideas. They were men who could look a deficit in the face without becoming hysterical, provided the deficit was of such a nature as to be a tremendous national asset in disguise. They were men who in days of depleted national revenue could formulate the wise policy of exempting schools and colleges from taxation, thereby placing a premium on intelligence. And not stopping with educational institutions, but realizing that knowledge and information are sought as often in the pages of periodicals as in the classroom, they took a step toward encouraging those who were ambitious to read and keep informed, by boldly cutting in half the Governmental postal revenue upon these periodicals.

Bear in mind that this was at a time when the stage-coach and pony express still carried a large portion of the mail to the remote parts of our country. It was at the time when the Post Office Department was confronted with a heavy deficit at the close of each fiscal year—not such a time as the present when it earns a surplus, as reported by Postmaster-General Burleson within the last few days!

And now comes the tax on intelligence that will add a burden of $17,000,000 upon those who are ambitious enough to keep themselves informed on current events or to possess themselves of up-to-the-minute information on developments in the arts, professions or trades.

On Dec. 9 the House Committee on Post Offices voted to include as a legislative rider on the Post Office Bill an amendment fathered by Representative Randall of California, applying the zone system, as applied to parcel post, to all second-class mail matter. Instead of the present flat rate of 1c. per lb., or an increased rate of 1⅓c. per lb., as advocated by Mr. Burleson, this committee makes the unthinkable proposal to discriminate against those American citizens who live remote from publication centers by taxing them as high as 6c. per lb. postage on all of their magazines, periodicals and newspapers. And this in spite of the fact that the Postmaster-General had recommended that the question be postponed until it could be ascertained what effect the change would have on the spread of educational periodicals.

The *American Machinist* has no quarrel with honest and intelligent postal reform. Nor, we are sure, have our readers any desire to defraud the Government of what justly belongs to it. But neither you nor we should sit idly by and permit a few unthinking representatives who can see no further than next year's budget to upset the broad-minded policies set down by wise and far-seeing statesmen. Just *two days* after the Post Office Bill was reported, this ridiculous rider was jammed through the committee. Two days to reflect upon a measure that will take $17,000,000 out of the pockets of the people who subscribe to periodicals! Hurrah, boys, hurrah; down with the cost of living and up with the cost of learning! Off with the tax on drinkables and on with the tax on thinkables! Let's give Shoats Corners, Wash., $500,000 for a marble post office and soak Tom Jones, who goes there to get his *American Machinist* every week, $5 a year extra for postage on his favorite paper!

We have not exaggerated this case a particle. The zone system as proposed for all periodicals proposes an increasing rate similar to the parcel post, culminating in 6c. per lb. for a distance of 1,800 mi. or over. The present rate is a flat one of 1c. per lb. anywhere in the United States. The weight of the Dec. 7 issue of the *American Machinist* was 33 oz. The average in November was 1.7 lb. Readers who live 1,800 mi. or more distant from New York are to be penalized approximately $5 each per year for being ambitious enough to desire to keep posted on machine-shop practice, because apparently of their bad taste in not picking out a publication center as a place of residence.

The revenue last year on 1c. postage was in round numbers $11,500,000. Mr. Randall, the author of this (headless) rider, estimates that the *average* second-class rate as proposed will amount to 2½c. per lb. Here is a net increase of $17,225,000. Bearing in mind that the Post Office Department earned a surplus last year, compare this boost of 150 per cent. with the cut of 50 per cent. made by the statesmen of 1885. Either we must be getting too much intelligence, or certain politicians must be having too little of it!

If the Congressmen of the United States really desire to institute postal reform, let them begin at home. There is a golden opportunity for reform in the franking privilege under which grand pianos and household furniture have been sent *by mail,* and through which every voter in the country is prior to election deluged with personal propaganda concerning the merits and achievements of the representative from his district. "To him who hath shall be given" is biblical, and true; but why should the

fellow who is lucky enough to be in office avoid the postage incidental to reëlection, while his more unfortunate rival who is looking for the job is forced to attach a 2c. stamp to every letter that he sends in search of votes?

The Post Office Department seems to be the most obliging department of the Government. It is not enough that the Agricultural Department sees fit to distribute free seeds through Congressmen to Tom, Dick and Harry—but our post office must also carry the seeds gratis. Possibly if the recipients wanted them badly enough to pay postage, there would not be so many of these gifts thrown away, to say nothing of the increased postal revenue that would result. The idea, of course, is to improve the agricultural art—no one will find fault with this ambition, even with potatoes at $2 a bushel and a Ford on every farm. But why, since we are a mechanical and manufacturing as well as an agricultural people, make the machine-shop man and the readers of other instructive periodicals pay the postage on Farmer Jones' seeds?

That this rider is not a sincere effort justly to apportion expense is undeniably manifested in that it specifies the retention of the free-in-county distribution of periodicals. In other words, the Government will undertake to distribute free of charge through its postal system the circulation of any newspaper unimportant enough not to go outside of the county in which it is published. And this distribution is in large part through the most expensive branch of the postal service—the rural free delivery. A goodly portion of that $5 annual tax that Tom Jones will be asked to pay in extra postage on his *American Machinist* will go toward carrying, free of charge, the *Buyrille Bugle* to Farmer Perkins, who lives 10 mi. from town on a free-delivery route! What with the free postage on seeds and the free postage on county newspapers, it looks as if we industrilists should be able to learn something about scientific management from the agriculturists.

Legislation that is rushed through a committee in two days cannot be discriminating, and discrimination is essential to just enactments. It would be idle to say that there are no abuses of the second-class mail rate, but it would be unjust if educational periodicals are compelled to suffer for the sins of others. We recognize the justice of taxing theatrical property and exempting school property—why not distinguish similarly between periodicals which instruct and those which amuse? Why place obstacles in the way of the circulation of reputable technical, trade and religious periodicals because certain unscrupulous publications parade their self-advertising at second-class rates under the cloak of a nominal subscription price?

It is argued that trade publications should suffer this unjust discrimination because of the advertising that they carry. You cannot separate the advertising from the editorial pages of a trade or technical publication and say: "These pages are educational because editorial; and these pages are not, because they are advertising." Advertising pages in a technical paper are informative. They do not correspond to the unrelated advertisements in the popular magazines, which have nothing in common with their editorial contents. Advertisements in technical papers are localized news items, invaluable to the man in the profession. All new developments in the mechanical line, when developed and proved successful, are considered to be fit for description in the editorial columns *once*. After that, they go into the advertising section. But to the man who has not had the issue in which they were described editorially, they are bona fide items of news and information, no matter in what part of the paper they are published.

And do not forget that the second-class mail matter is the inspiration that calls into existence a large part of the first-class mail. Ten thousand inquiries have been known to originate from a single page of advertising matter—inquiries that took ten thousand 2c. stamps to send to their destinations, and ten thousand more for the first reply.

We are not stating these facts because we are publishers of technical papers; but because, being publishers of technical papers, we see perhaps more clearly than others would see it the gross injustice that this proposed rider attempts to perpetrate upon the reading public who must ultimately pay the bill.

We object to the narrow-minded class legislation that would penalize the man who must get his education largely through reading.

We object to the unjust sectionalism that divides this country into a ring of zones, each ring imposing an additional handicap on the spread of information.

We object to the distinction that makes the mechanic pay the farmer's bill for postage.

We object to the step backward that we shall take as a nation if we discourage intelligence.

And you, Mr. Randall—do you, as the father of this proposal to tax intelligence, realize its consequences to the people of your own state? Do you realize that you are doubling the cost of nine-tenths of the reading matter that goes to the citizens of California—that you are placing a serious obstacle in the path of the mechanics in California's shops, the civil engineers who build California's bridges, the mining engineers who develop California's mineral resources?

You, and the *county weekly that you own* and that the Government circulates to your subscribers free of charge, will not be hurt by this bill, Mr. Randall; but the men in your state who are interested in things that occur outside of *your* county will be hurt, and we venture to say that they outnumber you a million to one.

And you, Mr. Reader, make it a point, as a patriotic citizen, to write your Congressman that you heartily disapprove of the Randall tax on intelligence.

Rights of Mine Locator

By A. L. H. Street*

The Nevada Supreme Court has adjudged to be void a contract by the locator of mining claims on public lands to abandon them, on condition that the other party pay him $100 monthly until sale of 160 acres of the land, apply for withdrawal of the lands under the Carey Act, and share the proceeds of their disposal. (Miller vs. Thompson, 160 Pacific Reporter, 775.) The court holds that such a contract is impossible of performance because the Carey Act does not permit sale of lands withdrawn under it, by the person withdrawing, but merely authorizes development of an irrigation system and sale of water therefrom to settlers making entry under purchases from the state.

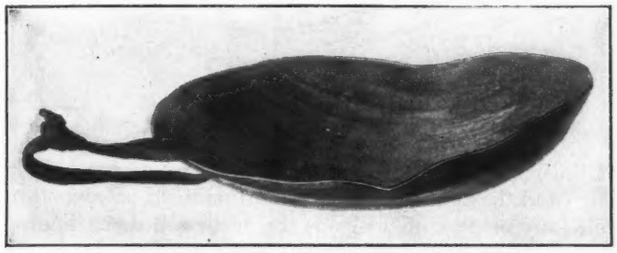
*Attorney at law, 829 Security Building, Minneapolis, Minn.

Details of Practical Mining

The Old Horn Spoon

There are a few old prospectors who still swear by the horn spoon shown in the illustration. Although a description of the manner of its use is almost superfluous, it is doubtful if many mining engineers have such a tool as this in their kits, while it is probable that a large percentage of mining men have never had the opportunity to see one.

A spoon of this size is a handy adjunct in placer work, in preliminary concentration tests, etc. It also has a wide range of general utility, being a convenient drinking cup which can be carried on one's saddle without danger of breaking and available for such use without dismounting; serving as a food container in an emergency; and, though less frequently, as a protective shield for the body in knife duels.



THE SPANISH-AMERICAN HORN SPOON

The particular specimen shown here has had an interesting history, being a relic of the old days of patio amalgamation in Mexico, with possibly an earlier history in Peru, and during the last decade having passed through many hands of greaser and gringo by theft, purchase and fiduciary custodianship.

Hints for Operators of Small Mines

Many small mines in Rhodesia are worked by men who have had no training in either mining, mechanics or metallurgy, and these few notes have been presented in the *South African Mining Journal,* in the hope that they may be of assistance to such individuals in the economical working of their properties. To assist in gaining access to or egress from stopes, timbers are often fixed between hanging and foot walls or short jumpers fixed in either wall. In many cases these are placed at inconvenient distances apart, making it awkward to climb out. A result of this is that a miner, when blasting in such a stope, has to use extremely long fuses to insure his safety, whereas if a few extra timbers were put in to facilitate his movements, considerable economy might be effected in the amount of fuse used.

Where there is machinery running regularly on the surface the installation of a small electric-lighting plant to effect a saving in candles is well worth considering. Usually, a convenient countershaft can be found, from which a small electric generator can be driven. A generator of 2 kw. capacity will run about a hundred 16 cp. lamps, and the running costs of such lights per 24 hr. should not exceed 10s. In few cases, however, would all lights be on full time, and therefore the daily cost would be considerably less. Even where no countershaft is available, a small self-contained oil engine and generator installed will often be profitable. Truck tramming is in most cases done with two boys per truck. This is necessitated by sharp rail curves or bad grading of track. If a track is laid off with easy curves and with a grade in favor of the loaded truck of about ½%, one native can easily handle a 10 cu.ft. truck. Incidentally, with the track graded in favor of the load, there is natural drainage for water to the station.

In a number of small mines it has been found economical to make each drill boy responsible for his own drill steel. The method usually followed is to issue to each boy sufficient drills to enable him to drill the requisite footage per shift. He carries his own steel to the face and returns it to the drill sharpener for dressing, and is responsible for recovering the same steel again from the drill sharpener. As the drills wear out, the short worn end has to be returned before a new one is issued. This system where tried has been found to be satisfactory and economical, few, if any, drills being ever left behind in the mine.

A large number of picks are purchased annually by small workers, and this number could be considerably decreased if, instead of discarding picks as points get short, new steel be welded on each end. This work can be most profitably done by collecting short picks, so that a number can be done in one job. Drill hammers the faces of which are out of shape should also be collected, as a blacksmith can face them up and retemper them.

Steel wire ropes, whether used on hoisting engines or on windlasses, should be regularly greased, as the life of the rope is thus materially increased.

Pumping Economies and the Use of Warm Feed Water in the Power Plant

Pumping water from underground by steam pumps is responsible for a large consumption of fuel, on account of the heavy condensation of steam in pipes and the large consumption of steam per horsepower with the usual positive-motion pump. In many cases this method of pumping cannot be avoided. In all pumping schemes particularly from permanent stations, full consideration should be given, however, to the economies which can be effected by the installation of electric or other methods of pumping. Boilers and steam pipes should in all cases be carefully lagged with nonconducting covering, as the initial outlay will be quickly recovered by the saving in fuel consumption and general wear and tear of boiler. Scale in boilers causes increased fuel consumption, and heavy scale endangers the life of the boiler. River waters are, as a rule, free from incrustation solids, but most underground water requires treatment before use as boiler feed. In all cases a sample of the water should be sent to an

analyst, who will give a certificate of analysis with notes as to correct treatment. The quantity required for an analysis is about a quart. The cost of analysis is small, and the large majority of waters can be easily and cheaply treated, and the results achieved by such treatment fully justify the small expenditure involved.

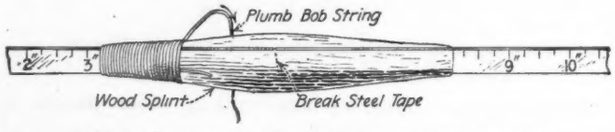
Unless absolutely unavoidable, cold feed water should not be introduced into boilers. The exhaust steam from engine, pumps, etc., should be utilized for heating the feed water. Economizers for this purpose can be purchased, but in many cases an apparatus can be constructed on the mine. An advantage in heating the feed water to about the temperature of exhaust steam is that magnesia or carbonate of lime in the water is thrown down before the water enters the boiler. If exhaust steam is introduced directly into the feed-water tank, precaution should be taken to eliminate oil before the water enters the boiler. Ashpits under fire grates of boilers should be made deep, and in no case should accumulations of hot ashes be allowed to remain in them. A large number of new fire bars are annually used, and the majority of these are required because the old ones get bent and destroyed by hot ashes in ashpits. It is more economical to run two boilers, each with an easy load, than to force one boiler, overloaded, to do the same work.

Field Mend for Steel Tape

By Hale H. Hunner*

Although there are several quick-repair menders for steel tapes on the market, it usually happens that they are in the office when the tape breaks. I was taught this simple mend by a practical surveyor several years ago, and have used it a good many times since and never had the least bit of trouble in making it hold as long as I cared to leave it on. I have worked for a week in the woods with two of them on the tape without having to be touched except for an occasional soaking.

When the tape breaks, cut a straight piece from a green alder or willow about 3 in. long. When the stick is split down the center and peeled, it should just cover the tape laid lengthwise. Smooth up the split faces and shave down the outside from the center of each half to a thin



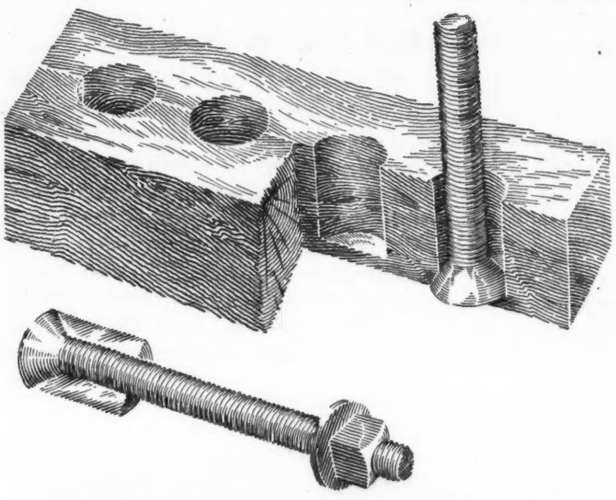
MENDING A TAPE WITH WOOD AND STRING

edge. About 3 ft. of plumb-bob string or stout cord will serve to wrap the splints. The cord should be wrapped as tight as possible each time and care taken to see that the binding does not have a chance to slacken up. When the splint is nearly half wound, place the broken ends together right side up and finish winding until the splint is entirely covered. A minute's soaking in water will remove any possibility of slipping. If it should slip at all, it will pull entirely out, thus there is very little chance of getting wrong chainage. It slides through the brush and around rocks with very little hindrance and while it puts a stiff place in the tape the advantage of a quick field repair overbalances the disadvantage.

*920 Third Ave., Hibbing, Minn.

Making an Expansion Bolt

Making an expansion bolt that is satisfactory, especially for light work, is an easy matter when done as illustrated, according to F. F. Sengstock in *Power* for Dec. 19, 1916. Make a mold by clamping together two blocks of wood and boring a hole (half in each block) the size



MOLD TO CAST LEAD SLEEVE AROUND A BOLT

of the hole into which the expansion part of the bolt is to go and the depth required. Into this mold place a stove bolt (any other kind will do) threaded well down toward the head as shown, and pour molten lead around it. When the bolt is placed in position and the locknut is tightened down hard, the lead will swage out and hold the bolt securely. A countersunk head will help the bolt to expand the lead sleeve.

A Light Spad Drill

The instrument and method described by W. S. Herbert in *Coal Age* recently are possibly not new, but they may be of interest to many engineers who do underground surveying in mines with wall rocks not too hard.

A hand drill for drilling spad holes is apt to be heavy and cumbersome, and carrying it about through the

THE DRILL AND A SPAD HOLE

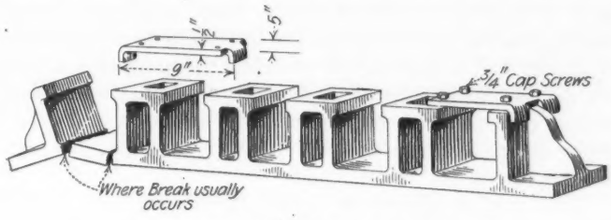
mine requires much time and energy. A ⅝-in jumper drill, similar to the one shown herewith, and a hammer accomplish every purpose. By their use a hole may be quickly drilled into which a ¾-in. wooden spad plug may be driven. The drill is light and can readily be slipped into the pocket, so that but little effort is exerted in carrying it about and it beats chasing around to find a Cousin Jack who can be taken away from his work to drill the small hole needed.

Details of Milling and Smelting

Stamp-Guide Reinforcement

By Arthur C. Daman*

The 1,550-lb. stamps at the Aurora Consolidated Mines Co.'s mill produce excessive vibration, and the guide frames break frequently. To strengthen the frame, a



STRENGTHENING STAMP GUIDES

9x5-in. plate ½ in. thick is bolted on at both ends of it. The ends are the weakest points, all breaks occurring there. Since using the reinforcement plates, no frames have been cracked or broken.

Use of Diaphragm Pumps

In a paper to be read at the New York meeting of the American Institute of Mining Engineers, in February, 1917, and published in the *Bulletin* for December, 1916, Luther B. Eames, of Timmins, Ont., discusses "Counter-Current Decantation" and incidentally describes the pulp transfer plant at the Hollinger. This plant consists at present of five rows of 40-ft. tanks, four tanks to a row, forming a plant of five units. The tanks are arranged with a difference in elevation of 2 ft. 6 in. between steps with the final tanks of the series the highest, so that all solutions gravitate through and out of the plant to precipitation. The roof is supported on flat trusses, the lower chords of which pass just above the tank rims. These trusses also serve to support the thickener mechanisms and the walks between the tanks.

The diaphragm pumps used were designed by the company's staff. They are all three-throw or triplex pumps, so that in spite of the large tonnage handled the duty on each diaphragm is light. It is not uncommon for diaphragms to last 300 days, while the life of the present type of valves and seats has yet to be determined.

The pumps are used not only for pulp transfer, but also for the final discharge. This makes regulation of the final discharge for moisture much easier and more reliable, keeps the work of the operator all on the upper floor and allows the tailings to be discharged at a considerably greater elevation than would otherwise be the case.

The practice in most plants in the Porcupine district now is to use cone pulleys for the regulation of capacity, although some of the operators favor regulation by varying the length of stroke.

*2678 Eudora St., Denver, Colo.

The valves should be of the floating type, as any hinge device will catch the wood chips that are present in the best-screened pulp. The chips lodged in the hinge of the valve start leaks which, though small in amount at first, cause cutting of the seat and consequently permanent leakage. With the floating valve there is no place for chips to lodge and the whole circumference of the seat is washed by pulp at every stroke. This type of valve also has the advantage that the lower valve may be placed directly below the upper one and may be made small enough to be lifted out through the upper-valve seat when the upper valve has been removed.

The best results have been obtained when the working surfaces of both the valve and seat were of high-grade rubber. Belting was used at first, but it was found that minute leaks were almost sure to start, owing to the fact that belting is not yielding enough to close over any chip that may lodge on the valve seat and that a leak once started would ruin both valve and seat in the course of a few days. On the other hand, valves of rubber seating on rubber have operated six months without the slightest decrease in efficiency and with scarcely perceptible wear.

Diaphragm pumps have been operated at speeds varying from 15 to 100, the higher speeds usually in conjunction with a short stroke.

The practice at the Hollinger mill has been to use a low speed and a stroke as long as the diaphragm could safely stand. Measurements taken on the Hollinger pumps equipped with standard No. 4 Gould diaphragm at 3-in. stroke gave results as shown in the following table:

Number of Strokes	Volume per Stroke, Cu.Ft.	Specific Gravity	% Solids
14.5	0.139	1.54	54.5
23.0	0.148	1.48	50.5
Tons Solids Pumped per Day	**% Increase in Speed**	**% Increase in Volume per Stroke**	**% Increase in Tonnage**
76.3			
114.5	58.5	6.5	50

From these figures, which are typical of numbers of tests made, it may be inferred that the volume pumped is roughly proportional to the speed of the pump, but that leakage is slightly greater on the lower speeds.

The low speeds and the placing of the discharge lips high enough above the discharge valve to leave three or four inches of pulp over the valve at the end of the upstroke have rendered the pumps of the Porcupine district practically free from the splash and dirt that have been one of the chief objections to diaphragm pumps in the past.

Where tanks have a settling capacity of over 125 tons of solids per day, it may be found advisable to use two diaphragms in parallel, making a duplex or even a triplex pump. This arrangement has several advantages; with the lowered speed, strains of the pump are lessened and distributed, and repairs can be made on one unit without complete stoppage of the tank discharge. Diaphragm life appears to be roughly proportioned to the number of diaphragms employed, while a corresponding decrease

in the strokes per diaphragm does not result in an increased cost for diaphragms.

As a safeguard against waste and other foreign matter it is advisable to screen the pulp before it goes to the decantation tanks, and where small wood chips are to be expected a fairly fine screen, usually of punched plate, will be of great service in protecting the thickeners as well as the pumps.

Stamp-Mill Reports

By S. H. Brockunier*

One of the difficulties of preparing blank forms for mill, mine or other labor reports is the composing of something easily understood, which the workmen can readily and honestly fill in from the data encountered in his daily routine. Any blank form that will bring before his eyes the work he has performed during the day will be more likely to interest him and secure his coöperation than one so intricately planned or worded that he has to guess at the answer.

After trying various types of stamp-mill reports, with more or less success, the one reproduced herewith was composed. The idea incorporated in it was conceived while watching a dentist mark his chart indicating the treatment of a patient's teeth, hence the application of the idea is believed to be original.

The chart represents a 30-stamp mill as one stands in front of the stamps. Each battery has a number, and the chart column representing it is divided into five spaces, each representing a stamp. The usual repairs, changes or renewals are printed at the left, blank places being left for reporting unusual conditions, which should be written in when they occur. It is a simple matter for the millman to put a × in the column representing a certain battery or stamp, opposite the given repair, change or renewal. Spaces at the bottom of the report show the amount of "quick" fed, amalgam removed, and requisitions desired or filled, and another space is provided for reporting labor employed in the mill.

When these reports reach the office and are properly filed, it is an easy task for the clerk or superintendent to scan them quickly and catch the × showing any renewal or repair in question. One knows to the exact stamp and date just the information wanted without having to laboriously read a lot of matter foreign to the question. These charts are found a fine supplement to a tabulation. One cannot peruse them without getting near to the millman and his real need. They keep one informed better than a mere tabulation of figures from which all human feeling has been obliterated. In the use of this report the millman will not leave the manager in ignorance of his wants, for he is sure to stick some note on the margin, telling something perhaps previously unknown and many times giving the clue to the trouble the manager has been looking for.

This graphic report is easily tabulated for monthly reports, and may be worked out in many different ways. The report reproduced herewith indicates rather more than the usual ills of one shift in a mill, but is so given to more clearly illustrate the method. The chart shows that batteries Nos. 3 and 5 ran the regular time without trouble, only stopping to brush up the plates. Batteries Nos. 1 and 2 lost four hours each because of shortage of ore. Battery No. 4 had trouble with the shoe and die of the feed stem and the adjoining shoe on the second stem, and took advantage of the hang-up to change the screen. If new shoes or dies had been put in, the word "new" would have been put before the word shoes or dies. Battery No. 6 had a broken feed stem and lost an hour fixing it. The rest of the report is obvious.

Pennsylvania Gold Mining Co. Form No. 1

MILL REPORT

Nov. 25, 1916.

BATTERY NO.	6	5	4	3	2	1	REMARKS
Time run (hours)	7	7¾	6	7¾	4	4	
Hung Up (hours)	1	¼	2	¼	4	4	
Reason hung up							
Brushing	×	×	×	×	×	×	
New Screens			× × ×				
Shoes			× ×				
Dies			×				
Ore Short					×	×	
Fixed broken stem	×						

Quicksilver fed battery 18 Oz.

Quicksilver on plates 3 Oz.

Amalgam from plates 66 Oz.

Requisitions *broom, belt* 16″x48′—5 *ply.*

Supplies received 50 *ft. hose*—481 *oz. quick.*

Labor *J. Jenks, rockbreaker* 8, *Jackson, repair* 2.

J Boyd Millman

*Mining engineer, Nevada City, Calif.

The Assayer and Chemist

Assaying Gold in Copper Matte

By Roger E. Chase, Jr.*

The method described is the result of a number of years' experience in assaying copper matte running from 10 to 50 oz. Au, 20 to 200 oz. Ag and 30 to 50% Cu. During this period we averaged several carload lots per week and the sample of every lot was submitted to a certain well-known umpire. The method in all essential details has been in use for three years, and we have had no difficulty in winning our share of the umpires.

At first we attempted to assay this material by the ordinary crucible method with an excess litharge charge. This is universal practice in copper smelteries for the determination of gold and silver in matte. It calls for a 20-gram crucible (which has a capacity of about 175 c.c.) charged as follows: Sodium carbonate, 12 grams; litharge, 80 grams; silica, 6 grams; niter, 5 grams; matte to be assayed, ¼ a. t. This is stirred and the following cover is added: Litharge, 40 grams; borax glass, 15 grams; sodium carbonate, 12 grams. The muffle should be hot enough to insure a quiet fusion in 20 min. This method is quite satisfactory for low-grade mattes, but for the rich material in question the slag losses and cupel absorption were too high and the method was found entirely too erratic and unreliable.

Several scorification methods were tried. One called for several (five or ten) portions of $^1/_{20}$ a. t. each scorified in 2½-in. Bartlett scorifiers, the buttons to be cupelled separately and the beads combined in one parting cup. We abandoned this method for several reasons, the principal one being that it offers excellent opportunities for the multiplication of weighing errors at the pulp balance.

In another standard method, ¼ a. t. portions are scorified in 3-in. Bartlett scorifiers with about 85 grams of test lead. The matte is mixed with one-half the lead, after which the rest of the lead and a little borax glass are added for a cover. The assays are run in pairs, and the buttons from the first scorification are combined, made up to 65 grams with test lead, fluxed with 1 gram of silica and rescorified. The buttons still contain too much copper for cupellation and must be rescorified a second time. The results obtained by this method are certainly above criticism, but unfortunately, results are not always obtained. The temperature required for the first scorification is over 1,100° C., and I have been unable to find furnaces, muffles or scorifiers that would stand this heat for continued use. A slight drop in temperature at the start causes some constituent of the charge to separate out and float, effectively covering the lead and spoiling the assay. The muffles rapidly collapse, and the loss of scorifiers is extremely high. Nothing can be more discouraging than to nurse along an assay under such conditions only to have it leak out through a crack in a scorifier in the third scorification. It entails a serious loss of time and material, the former particularly annoying.

*3005 North Proctor St., Tacoma, Wash.

To overcome these various difficulties we finally adopted a scheme of our own, which is carried out in the following manner: Place 35 grams of test lead and 2 grams of silica in each of four 3-in. Bartlett scorifiers. Weigh out ¼ a. t. of the matte to be assayed and, by tapping the edge of the scale pan with the spatula, drop approximately one-half into each of two scorifiers. Repeat this operation with the other two scorifiers. (At first we made ⅛ a. t. weights by filling the bottoms of some 5-gram weights, but we found the method of splitting quarters to be faster and more accurate.) Stir and add 35 grams test lead and 2 grams borax glass as a cover. Open and scorify hot. Combine the buttons two and two and make up to 65 grams with test lead. Add 2 grams of silica and rescorify as before. The buttons will weigh about 20 grams and will cupel with feathers.

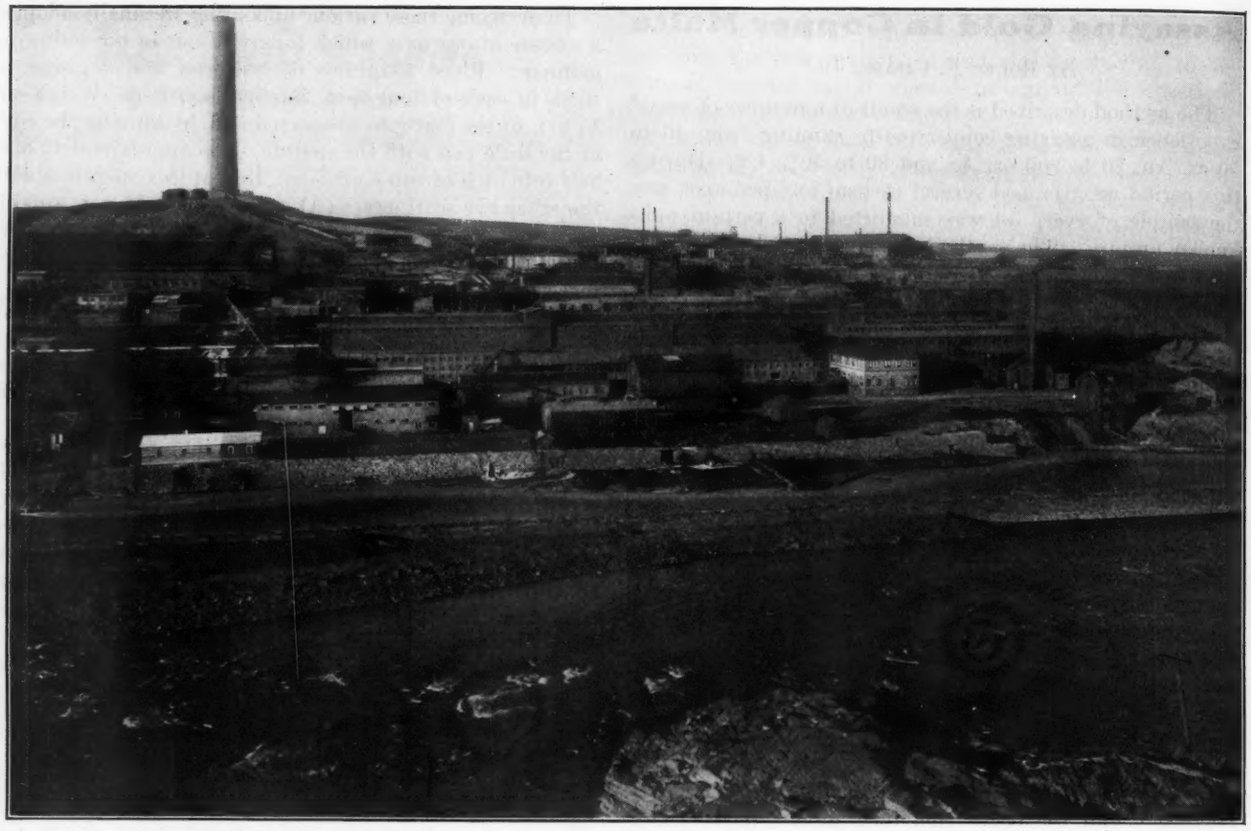
Flatten the beads on an anvil, combine them two and two in porcelain annealing cups and heat for 20 min. in dilute (1-5) nitric acid. Pour off the acid and heat 10 or 15 min. with nitric acid of 1.30 sp.gr. We use electric stoves wound so as to give a heat just sufficient to boil acid in these cups. Wash the beads first in hot dilute ammonia and then in distilled water. Dry and anneal. Each cup now contains, ready for weighing, gold from ½ a. t. This method has been found to be accurate, rapid, economical and easily worked.

Determination of Fluorine

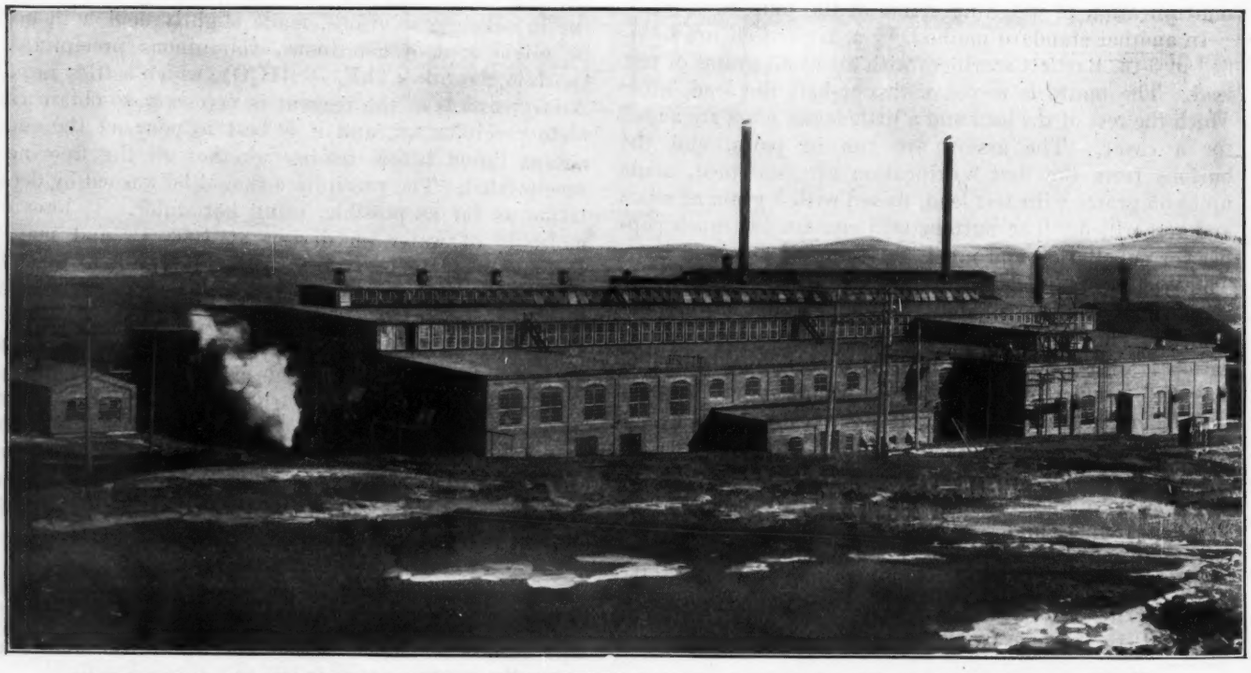
A new method of determining fluorine is given by F. Pisan in *Comptes rendus,* 1916, p. 791; abstr. *Journ. Soc. Chem. Ind.,* June 30, 1916, p. 709. The procedure depends on the fact that thorium nitrate gives with fluorine in alkaline solutions, made slightly acid with acetic or nitric acid, a gelatinous, voluminous precipitate of thorium fluoride ($ThF_4 + 4H_2O$), which settles rapidly. A large excess of the reagent is necessary to obtain complete precipitation, and it is best to pour off the supernatant liquid before testing whether all the fluorine is precipitated. The precipitate should be washed by decantation as far as possible, using hot water. It loses one molecule of water on drying at 100° C. and may be weighed after drying. It is better, however, to burn the filter paper and to convert the precipitate into thorium dioxide by strong ignition. Certain fluorides insoluble in water may be decomposed by fusing in a platinum crucible with five parts by weight of sodium carbonate, and after extracting the melt with water, acidifying slightly with acetic acid. Calcium fluoride and cryolite require fusion with 2½ parts of silica and 6 parts of sodium carbonate. The quantity of mineral required for the test is only 0.2 to 0.3 gram when the amount of fluorine present is between 5 and 8%.

Filter Paper. J. Grossfeld in "Zeit. f. angew. Chem.," 1916, xxix, p. 364, describes a filter paper capable of retaining the finest precipitate of barium sulphate, etc., has its pores filled with purified kieselguhr (nearly pure silica). On igniting the paper, the mineral matter is left as a coherent pellicle.

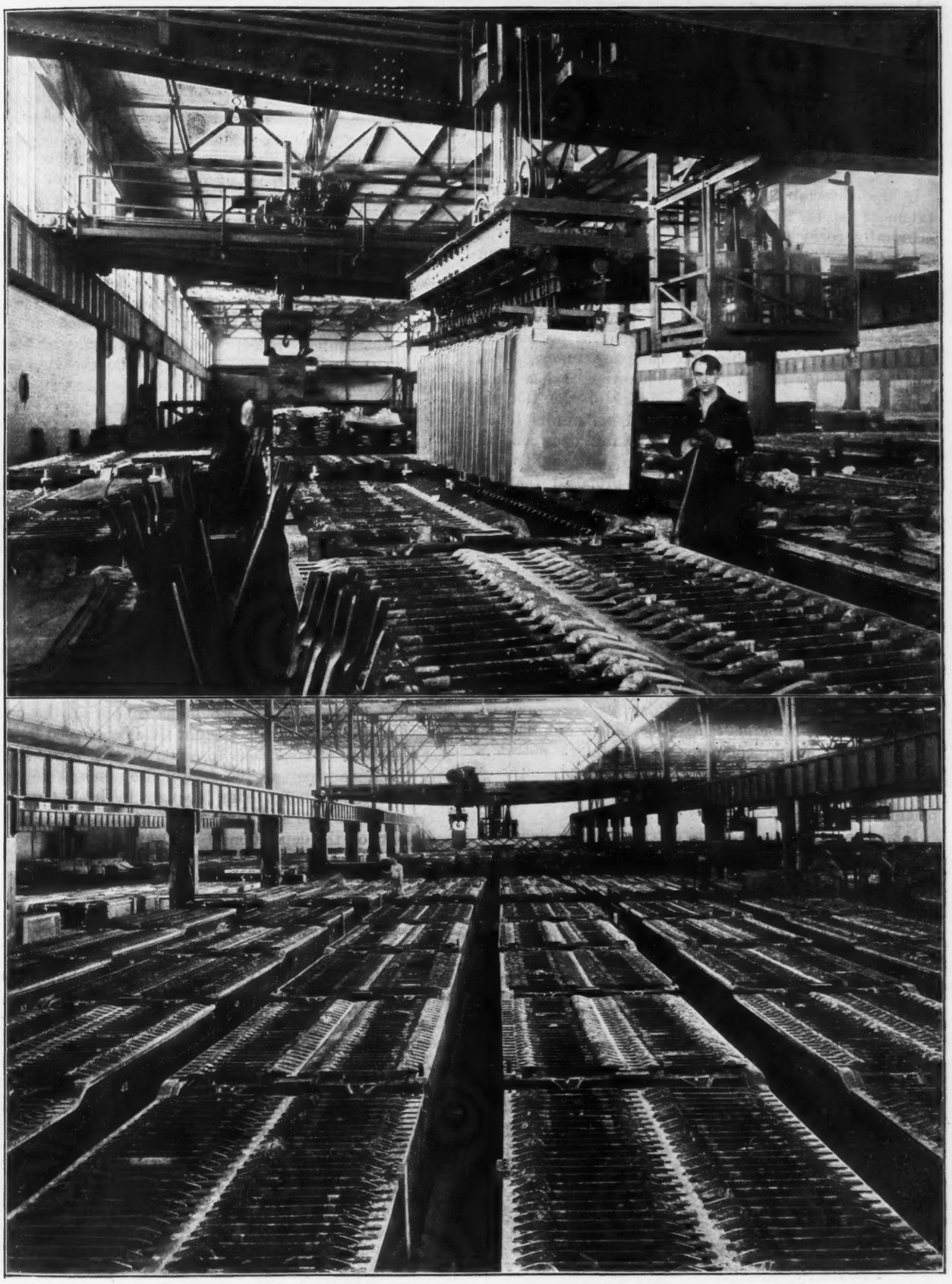
Photographs from the Field



GENERAL VIEW OF GREAT FALLS REDUCTION WORKS OF THE ANACONDA COMPANY



TANK HOUSE OF ANACONDA'S NEW ELECTROLYTIC COPPER REFINERY AT GREAT FALLS, MONTANA



INTERIOR OF CELL ROOM OF ELECTROLYTIC COPPER REFINERY AT GREAT FALLS

Lower illustration is a general view of the cell room; upper picture gives a closer view of the crane just after drawing copper cathodes from an electrolytic cell

Correspondence and Discussion

Minerals Separation vs. Miami

In the editorial in the *Journal* of Dec. 16 there is a statement as to the Miami Copper Co. which, while technically correct, gives, if one has not in mind the circumstances and the patent condition at the time, an incorrect impression as to the attitude of the Miami company. It says, "The Miami Copper Co. also defied the patents."

The circumstances were that some months previous to the time that the Inspiration company entered into negotiations with the Minerals Separation, I had incidentally spoken to one of the officers of the General Development Co. of some very remarkable results I had obtained upon Teziutlan ores in working upon one of the earlier stages of what has developed into the Towne-Flynn process. It was at the time proposed that, at the first opportunity, I go to Miami to carry out some experiments, which I afterward did. In the meantime Minerals Separation had carried out its original small test-plant experiments at the Inspiration.

The Miami management, basing its calculations upon the results of these original Inspiration tests and assuming certain figures as to cost, etc., had concluded that, "commercially," flotation did not compare favorably with the results of a gravity slime-concentrating scheme upon which they had been experimenting.

Just at this time the Appellate Court, at San Francisco, had declared the Minerals Separation patent No. 835,120 invalid. The Miami company was therefore not in a position to sign a contract with Minerals Separation—the first clause of which affirmed the validity of this patent.

It was necessary, however, to determine more definitely just what commercial advantages, if any, flotation presented. For that purpose a small agitation type of machine was built. Upon this purely experimental operation, the machine, although receiving its feed from the mill, was not a part of Miami mill operations, upon which the first infringement suit, afterward withdrawn, was brought. The infringement was the merest technicality, but served the purpose of getting the patent before the Delaware court.

The process actually used at Miami, as well as the one that I had originally considered using, is so entirely different in action from the Minerals Separation process that the officials of the General Development Co. very honestly believed that there was absolutely no similarity in the process, nor had their process or their first consideration of the subject of flotation any connection whatever with Minerals Separation.

A representative of Minerals Separation had called upon one of the officers of the General Development Co., but would not disclose what his process was, simply urging that some ore be sent him for test. It was only from the London address given and the description of the gentleman who had called that I recognized what the process was that he had represented.

Once brought into the court upon such a mere technicality—for the purpose of obtaining the legal status of the patents in question—the Miami Copper Co. is doing what any defendant is obliged to do, without any intention of defying any patent or any other law.

I am in no way connected with either the General Development Co. or the Miami Copper Co., having merely been called in for consultation, yet, I feel constrained to protest against any interpretation of the matter that might reflect upon the attitude of these people.

R. C. CANBY.

Wallingford, Conn., Dec. 18, 1916.

Lead-Plating Sheet Metal

In the *Journal* of Dec. 9, page 1,017, it is stated that it has not been possible hitherto to lead-plate metal so that the deposit will not readily peel off. This is entirely incorrect, as no difficulty is experienced in lead-plating, sheet iron, for instance, with a soft, dense and adherent coating.

Realizing the great value of lead-plated sheet iron for many structural and other uses, I have experimented considerably along these lines. The only difficulty has been that the minute particles of slag in the metal would not take the coating and pinholes would be left which developed rust spots on exposure. If it had not been for this difficulty, lead-plated iron would have been on the market a long time ago. At the present time it is hoped to perfect a method of treatment based on playing a gas flame over the surface part of the deposit deep enough to close the pinholes, but not long enough to heat the lead through to the iron and cause it to melt off.

Patents on the deposition of solid lead coatings and on the solid lead deposit as a product are owned by me.

Asheville, N. C., Dec. 12, 1916. ANSON G. BETTS.

The Big Pine Cyanide Mill

In regard to my article on the Big Pine Consolidated mill, in the *Journal* of Dec. 16, 1916, where I brought up the matter of the theoretical possibility of a continuous counter-current flow without pumps, it has occurred to me that I made one mistake.

I said that the thick pulp would discharge from the bottom of tank No. 1 into the top of tank No. 2 by its static head until it had reached the level of tank No. 1. This is not true, since the specific gravity of the pulp in the pipe is much higher than in the discharging tank. However, if we discharge from the bottom of tank No. 1 to the bottom of tank No. 2 and immediately dilute with fresh solution to the specific gravity of tank No. 1, the pulp in tank No. 2 would rise by its static pressure to the level of tank No. 1 and the results I claimed would be obtained. In the article I believe I have called the tank No. 2 above, "agitator No. 1."

CHARLES H. DUNNING.

Prescott, Ariz., Dec. 22, 1916.

Belgian Kiddies, Ltd.

The following authentic story of a heart-breaking experience by H. C. Hoover, was told in the New York *Times* of Dec. 21, by his friend George Barr Baker, a member of the relief commission recently returned from abroad. This alone gives a correct idea of what the Belgian Kiddies are suffering. It is one of the most appalling things of this whole terrible war:

"Mr. Hoover, accompanied by Dr. W. R. Kellogg, went to Belgium during the last few weeks and saw 1,200 of these children standing in line in a district near Brussels waiting for their food to be doled out to them. They were all school children, none of them being much over 14 years. All of them were happy—the poor little things had their food tickets in their hands and were facing the pleasant prospect of getting something to eat. Their mothers and others of the women relatives were standing by watching them.

"Suddenly Mr. Hoover saw one of the Belgian women who are working with the commission step over to the line and drag a child out of it. The child screamed and fought to get back into line, but the woman kindly but firmly forced it to one side. This was followed by other women doing the same thing, which was always accompanied by the screaming protests of the child.

"Puzzled by these extraordinary incidents, Mr. Hoover went to one of the women workers and asked why the children were taken from the line.

" 'They are of normal weight,' she said, 'and cannot have a meal today. They must wait until their weight is reduced before they may have food—this may be one or, perhaps, two or three days. Only those who are under weight and are facing starvation may have food. There is so little food that only those who need it most may have it.'

"Mr. Hoover was astonished and overcome, and asked the woman if it was possible that the children must be really starving before they could be allowed to have a meal.

" 'Yes, that is so,' she said, sadly. 'We cannot feed so many little mouths with so little. If we had the food we would give it to them—but what can we do? If America would only send it to us we would see that all these little children had at least enough to keep them at normal weight. As it is now, we are powerless, and those who do not show signs of starvation must stand aside for the less fortunate ones.' "

Some of the letters accompanying subscriptions for Belgian Kiddies, Ltd.,[1] stock are very interesting, and some are touching. Here are some samples:

Your solicitation for subscriptions in stock permits no argument, and I find the first dividend already declared as I write my check for ——. I am not very fond of Belgian hares, but a kid is a kid the world over, whether he may be white, black, yellow or Belgian, and a hungry kid is too awful to think about.

The last ladder that all we mining engineers will climb is the one leading to Eternity, and I am sure when that day comes, we will all look back on our Belgian and similar investments with the utmost satisfaction. May every mining engineer so live and conduct himself that when he makes the last climb on the ladder, it will be up the shaft and leading to the sunshine and not a winze leading to gloomy stopes.

It gives me pleasure to be able to respond to your appeal for the Belgian Kiddies, and I thank God that I can help a little to right a monstrous wrong.

The Belgian Relief Committee has, heretofore, not been asking enough from Americans. Urge them to *make sacrifices* and to give to the Belgians instead of giving each other Christmas presents.

I congratulate you on having made yourself so wondrously useful to these poor abused people.

Enclosed please find my check for —— to cover subscription price on —— shares of stock, to be issued as indicated on subscription slip and sent to me at above address. I expect to put these certificates in my kiddies' Christmas stockings.

Will you also kindly send me a half dozen subscription blanks with literature, that I may turn promoter. Several of my friends can get better returns on their money in Belgian Kiddies, Ltd., than are likely to accrue from some of the wildcat mining schemes they are playing with.

Reading in the *Evening Post* today of the Belgian Kiddies, Ltd., and your connection with it, I consider myself privileged to become a stockholder and enclose my check for —— to pay for —— shares.

Enclosed please find check for —— in payment of —— shares Preferred Stock in your corporation, these shares to be in the name of ——— and ——— both kiddies who know the worth of a square meal, at least judged from the general uproar if it is five minutes late.

Notice your announcement in *Engineering and Mining Journal* and as your stock is so highly recommended, I would be pleased to subscribe for —— share and enclose my check for —— in payment. Only regret that I am unable to invest more heavily.

I enclose herewith check for —— for which the —— kiddies would like to subscribe for —— shares of preferred stock in the Belgian Kiddies, Ltd.

The —— kiddies have read the statements contained in the prospectus of this corporation given in the last issue of the *Engineering and Mining Journal*, and they believe this to be a first-class investment, and are confident that they will receive dividends of 100% a day on this investment.

For papa's check enclosed please enter my subscription for —— shares of —— each.

December 15th—the day of the Great Protest at Carnegie Hall.

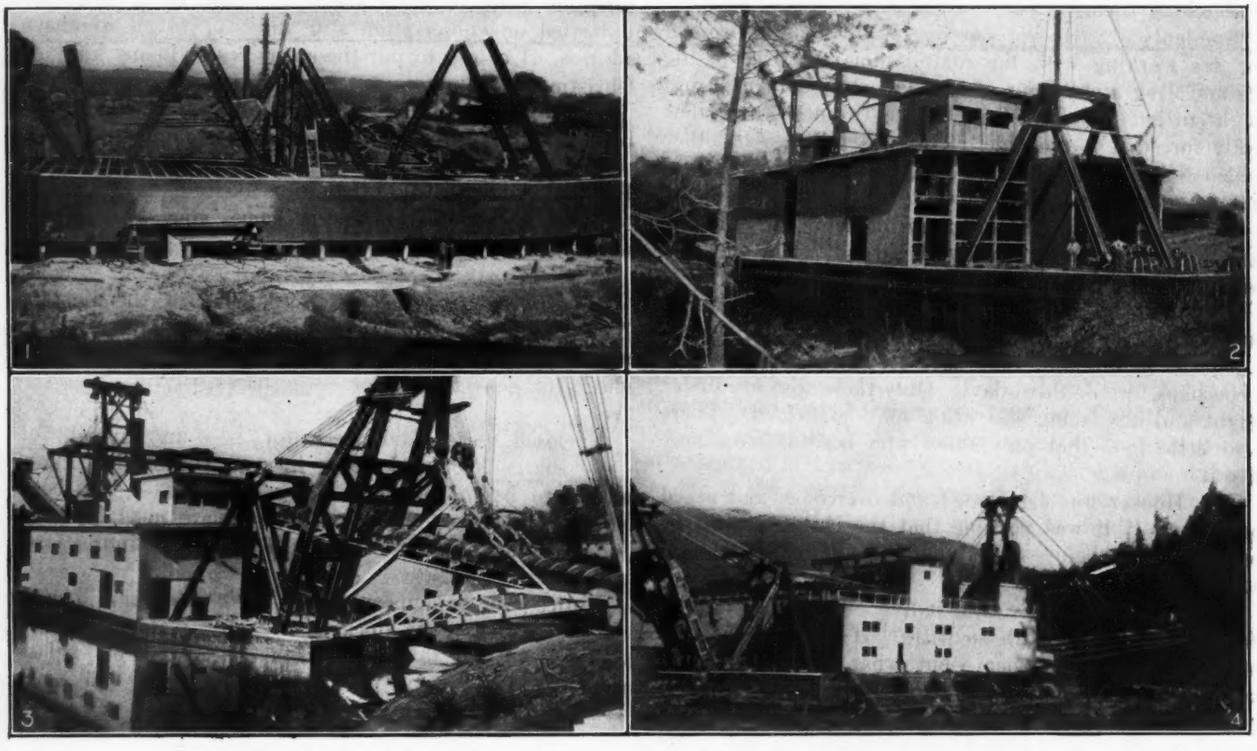
No New Year presents, investments or expenditures will bring such cheer as money sent to this project. Therefore subscribe!

[1]Belgian Kiddies, Ltd., Room 2124, 120 Broadway, New York City.

Steel Dredge Construction by Pacific Dredging Co.

The Yukon Gold Co. has installed, in record time, two all-steel gold-placer dredges, built by the Marion Steam Shovel Co., Marion, Ohio, in accordance with plans furnished by the Yukon company. One of the dredges was installed on the north side of Yuba River, 17 mi. northeast of Marysville in Yuba County, California, and the other on Coffee Creek, a tributary of Trinity River above Carrville in Trinity County.

The construction work on both dredges was handled by the regular employees of the Yukon Gold Co. and carried on in the name of the Pacific Gold Dredging Co., which is the operating company for the Yukon in California. H. C. Perring was superintendent of construction of the dredge on the Yuba River, with John Myers as foreman. H. C. McNaught superintended the Coffee Creek construction, with Oscar Wicks as foreman.



CONSTRUCTION VIEWS OF YUBA AND TRINITY DREDGES OF YUKON GOLD CO.

First photograph shows the dredge after 42 days of work. The second shows the housing completed after an additional 40 days of work. The third view is of the completed dredge, 4 months and 10 days after starting work on it. The last view is of the Trinity dredge, completed in 4 months 18 days

O. C. Perry is resident manager at Oroville of the Pacific Gold Dredging Co.

The dredges were built from the same plans and are alike except that the digging ladder of the Yuba dredge is longer than that of the Trinity. The Yuba was designed to dig 70 ft. and the Trinity to dig 60 ft. below the surface. Both have steel hulls and buckets of 9½-cu.ft. capacity. They are of very heavy construction, patterned after the dredges operated in the Folsom district by the Natomas Co. of California. The total weight of each is approximately 1,900 tons. The Yuba dredge was erected in 4 months, 11 days; riveting the bottom plates began June 19 and the dredge began digging Oct. 30. The Trinity dredge was erected in 4 months, 18 days; riveting bottom plates began June 25 and the dredge began digging Nov. 13.

The time which elapsed between the placing of the orders for the hulls and machinery with the Marion company and completion of the dredges (amounting to 9 months and 20 days for the Yuba dredge and 9 months and 27 days for the Coffee Creek dredge) was probably the shortest on record for steel-hull dredges.

All materials for the Yuba dredge were hauled 14 mi. from a spur of the Southern Pacific R.R. near Marysville, while those for the Coffee Creek dredge were hauled from Redding over the Trinity Mountains, a distance of 58 mi. The contract for the hauling of materials for both dredges was given to Henry J. Brandt, of Bakersfield, and was completed in less than four months. He had as many as 260 mules in harness on the Trinity Mountain road at one time. The hull sections were reduced in weight as much as possible, and the spuds, digging ladder and tails-conveyor frame were all hauled over the mountains before being assembled and were set up and riveted on the ground at the construction camp. Over 94,000 rivets were driven on the Coffee Creek construction, and 70,000 on the Yuba construction.

The hulls of these dredges are 135 ft. long, 60 ft. wide and 11 ft. deep. The well-holes are 77 ft. long by 7 ft. 4 in. wide. The digging ladder is 124 ft. 4 in. long, 9 ft. 4 in. deep by 4 ft. 5 in. wide, of plate-girder type of construction, as clearly shown in Fig. 3. Each dredge is equipped with two spuds exactly alike, of the box type, 70 ft. long 34x54 in. The upper tumblers are of nickel-chrome steel, shrunk on the shaft, which is of 18-in. diameter. The lower tumblers are of manganese steel of the round type, pressed on the nickel-steel shaft.

The buckets, are of two-piece manganese steel, made by the American Manganese Steel Co. of Chicago Heights, Illinois. The bucket pins are of 6¾ in. diameter, and 2 ft. 7½ in. long. The pitch of the buckets is 2 ft. 11 in., the weight of each bucket, without pin, is 3,000 lb.

The tails-conveyor frames are 155 ft. long, 7 ft. deep and 4 ft. 10 in. wide, of lattice-girder type. The conveyor belts are 36 in. wide and 318 ft. long.

The screens are of the revolving type, and the gold-saving tables are arranged double-banked. The pumps were built by the Yuba Construction Co., each dredge having two 12-in. pumps, and a 6-in. two-stage pump. The electric apparatus is all of the General Electric type, the motors operating at 2,200 volts. Each dredge has motors of 645-hp. capacity. The main-drive motor for the digging end of the dredge is rated at 300 hp.

The rated capacity of each dredge is 200,000 cu.yd. per month.

Molybdenite-Tungsten-Bismuth Developments of Queensland

By M. Vingoe*

The prices obtained by miners for molybdenum and tungsten ores since early in 1912 is a reflection of the demand for special steel alloys in which these metals are incorporated. The price of molybdenite, which was £2 per unit f.o.b. Cairns, or about £200 per ton for 96% ore in March, 1912, rose progressively to £550 previous to July, 1914.

Since there were but few known deposits of value, the high prices obtained for the product stimulated prospecting, and many places hitherto regarded as of negligable value have received attention with results most promising for the future production of molybdenite.

Records of mineral won and prospecting work done, regularly published in the *Queensland Government Mining Journal,* conclusively show that production increased by over 50% in 1915 compared with the preceding year. The annual production of North Queensland opproximates, and may this year exceed, 150 tons.

The mining district known as the Chillagoe gold and mineral field produced the greater portion of Australian molybdenite output. Wolfram township is associated with early exports of tungsten ores, and the surface deposits are believed by many to be payable at considerable depths, the tungsten being associated with molybdenite and metallic bismuth.

The characteristics of the wolfram district, which is only a small portion of the Chillagoe field, are well known. The metals are not found to any extent in defined lodes or fissures, but appear to have been intruded through faults in the granite country. The pipes or shoots are often erratic in their course and present faults and pinches in a manner most exasperating to the miner. Often when a pipe enlarges, the ore becomes leaner and unpayable. Mining proper, as practiced on well-defined lodes, is unknown here. The miner follows the quartz pipes, which are tortuous in direction and uncertain in extent and continuation.

The richest portion of the district contains a few leases of value. One or two of the shafts bottom at 300 to 400 ft., and at present the ore is not very promising at that depth. On one lease a shaft has been sunk through a diorite overlay passing through granite and porphyry at 300 to 400 ft., and fortunately intercepting at less than 500 ft. one or more quartz pipes. The latter are apparently rising toward the surface on adjoining claims already being worked at higher levels. The general opinion of geologists who have visited this center is that the pipes, or shoots may tend to become larger with depth, but the metal content will become more sparsely distributed. Indications in some of the hitherto best-paying mines at present confirm this opinion. One of these mines, a large and consistent producer of the three rare metals for several years has ceased operations in the main shaft in consequence.

Efforts have been made from time to time to consolidate the field by a large capital issue, buying out the present owners and mining according to uptodate methods. A mining company holding large interests in the field has in late years found direct control unprofitable and except in one or two places has abandoned regular mining and encouraged leasing.

In view of recent developments it would appear that the position formerly held among producing centers by Wolfram Camp is seriously challenged. The characteristics of the lodes from a mining point of view, the high values placed on their holdings by present mine owners, and the onerous labor situation, yearly becoming more acute, all combine to present a serious problem to the capitalist who would endeavor to create a unified holding.

The more recent developments already referred to consist chiefly of the discovery of various bodies of quartz in the Chillagoe and Etheridge districts, which on prospecting, have proved to be real fissure lodes containing payable and in some cases high-grade molybdenite, often associated with wolfram and bismuth ores. One property especially is receiving considerable advertising locally, and on paper apparently presents good prospects for a stock company. Many claims and leases have been taken up on adjoining land, and in the event of a successful flotation of the main property the holders of these claims would probable be able to liquidate at very advantageous terms. Be this as it may, the *Queensland Government Mining Journal* reported in the June issue a probable production of ore from the first 100 ft. on the lode in question of one claim alone, valued at present prices at over £26,000.

There are other fissure lodes in this and adjoining fields which promise equally good mining speculations. One of these, reported upon favorably in August (1915) number of the *Queensland Government Mining Journal,* extends over a mile in length and is considered to be a fissure lode of great constancy. Throughout its length there are deposits of molybdenite, wolfram and bismuth in the quartz body, from the surface down, and one prospecting shaft sunk 100 ft. has been driven through payable ore without encountering a single lean spot.

In North Queensland the future of mining these particular metals depends largely on ruling prices. If prices fall to the 1912 level, it will mean the closing of many mines unable to support the high mining costs which ever tend to increase. A large company could not successfully compete with the small producer over such a scattered producing area. A leaser or independent "fossicker" in the limitless back country will be content to burrow and

*Manager, Twisp Syndicate, Wolfram, North Queensland.

mine for months, obtaining a subsistence of 20 to 30 shillings weekly, in the hopes, often realized, of making a "strike." The same man, discouraged by lack of success, may take to day labor in a payable mine and obtain a remuneration of from £4 to £6 weekly for an actual working week of 41½ hours, thanks to the strong Australian Workers Union. Such are some of the encouragements offered to capital to develop properties which otherwise will be only scratched by the independent miner and abandoned when the shaft begins to deepen and costs increase.

It is expected that the newly formed Australian Metal Exchange will take hold of these and other metals when the Imperial Requisition is lifted and a regular quotation will then replace the present competitive bidding.

Some accounts and samples of molybdenite ore from the Western States of America have been received on this field, and an American enterprise which had intended operating in North Queensland has diverted its interest to the new fields nearer home, where it is stated labor is more efficient and a fair day's work is still obtained for a fair day's pay. The delay and difficulty attending successful treatment is said to be retarding actual production in those parts, but the deposits are evidently to be reckoned with in the near future of the molybdenite market.

The successful treatment of molybdenite involves an oil-flotation process, and although efforts have recently been made along progressive lines, much remains to be done before good recovery can be commercially made. It is believed, however, that a little careful experimenting will completely solve the problem.

The British Copper Restrictions

The following order [Serial C, 3011] was issued by the Ministry of Munitions of War, dated Dec. 8:

The Minister of Munitions in exercise of the powers conferred upon him by the Defence of the Realm (Consolidation) Act, 1914, the Defence of the Realm (Amendment) No 2 Act, 1915, the Defence of the Realm (Consolidation) Regulations, 1914, the Munitions of War Acts, 1915 and 1916, and all other powers thereunto enabling him hereby orders as follows:

(1) No person shall as from the date hereof buy, sell or, except for the purpose of carrying out a contract in writing existing prior to such date, enter into any transaction or negotiation in relation to the sale or purchase of copper of any class whether wrought or unwrought situated outside the United Kingdom unless such person is authorized by a special permit from the Minister of Munitions to purchase or sell the same. All applications for Special Permits shall be made to the Director of Materials, Armament Buildings, Whitehall Place, London, S. W., and marked "Copper Permit" and all persons to whom such permits are granted shall observe and perform all the conditions subject to which such permits may be granted.

(2) All persons shall, except as below mentioned, not later than the 16th day of December, 1916, send in to the Director of Materials, Armament Buildings, Whitehall Place, London, S. W., returns of: (*a*) All unwrought copper at the date hereof held by them in stock or otherwise under their control; (*b*) All unwrought copper due at the date hereof for future delivery to them; (*c*) All contracts existing at the date hereof for the sale to or purchase by them of unwrought copper.

Notwithstanding the above no return is required from (1) any manufacturer or smelter of stock in hand or due for future delivery for the sole purpose of manufacture or smelting at his works; (2) any person whose total stock in hand and due for future delivery does not exceed two tons.

By a further Order of the same date [Serial C, 3012] the Minister of Munitions gives notice: (1) That in exercise of the powers conferred upon him by the Defence of the Realm (Consolidation) Act, 1914, the Defence of the Realm (Amendment) No. 2 Act, 1915, the Defence of the Realm (Consolidation) Regulations, 1914, and all other powers thereunto enabling him he hereby prohibits as from the date of this Order the use of copper whether wrought or unwrought in any kind of manufacture except for the purposes of a contract or order for the time being in existence certified to be within Classes "A" or "B" of circular L. 33 as to control of output issued by the Minister of Munitions on March, 31, 1916. (2) That the Order of the Minister of Munitions on November 6, 1916, relating to the manufacture of copper wire and cable containing copper is hereby cancelled.

All applications in reference to this Order should be addressed to: The Ministry of Munitions of War, Priority Branch, 1 Caxton Street, Westminster, London, S. W.

The Ministry of Munitions announced that they had appointed Cecil Budd, of Vivian Younger & Co., London, and R. M. Rucker, of Henry Rodgers, Sons & Co., London, as a committee to advise the Ministry on the purchase and distribution of copper. Mr. Budd is chairman of directors of the London Metal Exchange, and Mr. Rucker is chairman of the Metal Exchange. Mr. Stroud, of Charles Tennant & Co., will act as secretary to the committee.

Minerals of French Indo-China

A recent review of French Indo-China, by Lawrence P. Briggs, United States Counsul at Saigon, published as a supplement to *Commerce Reports,* of the Department of Commerce, at Washington, points out how much the zinc industry has profited by the war. After the dullness of the last few months of 1914, the price of zinc rose to several times its former figures, and the industry developed as fast as possible under the limitations of lack of machinery and of European supervisors. Shipments of zinc last year totaled 33,335 tons, of which 17,903 tons went to France, 7,825 tons to Baltimore and Galveston and 7,602 tons to Japan. In 1914 the exports amounted to only 19,562 tons. In the first half of 1916 zinc exports from Haifong amounted to 19,699 tons.

Tonkin also exports tin, tungsten and antimony. Shipments of tin and tungsten ore or wolfram, amounted to 397 tons in 1915, against 216 tons in 1914. The customs figures show that 161 tons of ore were exported during the first seven months of 1916, but it is doubtful if these figures are exact. The ores are sent only to France.

Exports of antimony ore, which also goes to France, amounted to 833 tons in 1914, 630 tons in 1915 and 498 tons during the first seven months of 1916. A plant for the reduction of antimony ore is in course of construction near Haifong.

Editorials

The Position of the Metals

The change that occurred in the position of the metal markets in December was pronounced and without doubt indicates the turn of a tide, just as did the change last May. Indeed there was a good deal of similarity in the events. The momentous news of Dec. 12 was simply contributory to hastening what was already developing.

Thus, in spelter we had the first great advance in 1915 when the price rose to about 25c. followed by a decline to about 10c. Late in the year began a secondary advance which in the spring of 1916 culminated at about 18c., followed by a decline to about 8c. In the fall of 1916 began the third advance, which culminated at about 13c. Each of these major upward movements was less powerful than the one preceding.

The third advance attained its climax at the end of November. On Dec. 1 speculators attempting to liquidate found that there were few buyers, and they began immediately to offer at concessions in order to sell, small producers joining in the movement. The big producers stood aloof; not being sure that it was anything but a temporary recession that had started and recognizing that any aggressive offerings on their part would simply precipitate the decline. The latter was well under way and important interests had become definitely bearish before the German peace proposal came. The disturbance produced by the latter simply carried on in spelter what had already begun.

In lead the situation was different. The position of this metal had become quite tight. Producers in general had booked their expected supplies up to February. The market had passed largely into the hands of speculators, who were promoting the advance on small transactions, the principal producer resisting as best it could, adhering to its declared policy of keeping the price for lead within bounds, out of regard for the broader interests. Thus, we had the A. S. & R. Co. quoting 7½c. while the outside market was much higher. This was a repetition of the experience of last March, but it turned out to be briefer and less pronounced. Lead momentarily touched 8c. in the outside market just before Dec. 12. It is uncertain whether the wavering preceded or coincided with that date. Anyway, the unsettlement that developed then put an immediate end to the speculation in lead, and the premium in the outside market vanished almost overnight. Prompt lead which previously had been so scarce turned out to be available and the whole situation became easier. However, the steadying influence of the principal producer exhibited itself in this juncture, just as it had in retarding an extravagant advance.

As for copper, the boom culminated distinctly on Nov. 18, which date marked the end of the enormous buying. After that the transactions were relatively small—indeed, very small—but the situation was such that even they produced a further advance in price, while as for prompt copper it was apparently so scarce that anybody who could supply a little of it could get about anything he was pleased to ask of somebody who had to have it. Yet, this situation differed from that of last May only in that the producers were sold further ahead and the level of prices was a little higher. The same sequences were bound to occur. Even in November there were strong suspicions that some consumers had overbought.

With the news of Dec. 12 and the immediate collapse in the stock market, the copper market was stunned and experienced a sort of paralysis, but after a few days some people were minded to sell copper. It was curious how the pronounced scarcity of prompt and early copper immediately disappeared. Dealers who had nothing to offer acquired millions of pounds almost overnight. Whence did it come? Why, from consumers who made up their minds that they were not going to need all for which they had contracted—perhaps at 27 or 28c.—and deemed it wise to take a profit while the going was good. Of course, the premiums practically vanished then and the whole market declined.

There had been, however, some consumers who had not covered their first-quarter requirements and when the price reached 33@34c. decided wisely to wait and take their chances. Their opportunity came soon after the middle of December and some of them bought, although others continued to wait. This uncovered interest proved to be of great value in checking a decline, which might have been disorderly if there had been no buyers. In this respect also the December situation was different from that of May-July.

We are manifestly going to have a perplexing condition in the copper market for months to come. The producers have sold their expected production to the middle of 1917 and their contracts are good, i.e., their copper is going to stay sold. On the advance their sales were diminishing, as is always the case, and the average of their sales for the first half of 1917 is nothing like the figure to which the market advanced. Something like 26½@27c. is probably what they are going to get. But having thus contracted their copper they are not going to be in the market for a long time to come, except for the relatively small extent to which they may turn out to have undersold, i.e. to which their production will prove to be larger than expected. If we are on the threshhold of a contraction in consumption, manufacturers who have booked copper will doubtless sooner or later request producers to postpone deliveries, which will put producers in possession of supplies. For the present, however, the market is likely to be made by consumers who are willing to resell and consumers who are still uncovered, which will restore equilibrium in a situation that had become distorted.

What will happen after that, who now can say with assurance? The one thing that can be pronounced with certainty seems to be that in copper, as well as in the other metals, the period of wild speculation and inflation is over. This will be a blessing to all concerned—producers, manufacturers and consumers. Even will it be a good thing if prices recede to reasonably profitable levels.

Belgian Kiddies

The stories that Mr. Hoover and his associates tell of the condition of the children of Belgium are heart-rending. Hoover has given up two years of his time—and as we all know his is very valuable time—to the amelioration of their suffering. What pains Hoover a good deal is manifestly that his countrymen have not backed him up as they should have done. It is not too late for them to make good.

We appeal to mining engineers and to mining men generally to come forward and lead the way. It is up to them especially, for Hoover is a mining engineer—a California mining engineer—whose achievements have glorified the profession. They have got to make good. Never mind formalities, subscription blanks, etc. Simply send a check to Herbert C. Hoover, 120 Broadway, New York, with a note that it is for the Belgian children.

The mining industry has profited from the war as much as any other, probably more than most, for the steel, copper, zinc and lead mining companies have notoriously paid large dividends. Mining engineers have participated in them. Let them now be generous.

The Development of the Small Mine

A correspondent, evidently the developer of a small mine, writes us as follows:

> There is a stage in the mining industry and a necessary one; namely, after the discovery of mineral-bearing ground, the getting it in shape to be worth while to bring to the attention of capitalists. People like us would like to know what to do to put our properties in shape for engineering examination.

This letter might be answered in several ways and if referred to half a dozen authorities would probably bring forth as many different replies, several of which might contain suggestions of value to the writer of the letter. Not knowing the worldly circumstances of "people like us," not knowing the character of the deposit the writer had in mind and not knowing exactly what he would propose to do with the "attention of capitalists" when obtained, the reply must assume certain premises.

Presuming that "people like us" are prospectors with plenty of vitality but with little capital, with plenty of good common sense but with few strong financial friends; presuming that the deposit is a vein or an outcrop of low-grade precious or base metal, and presuming that the capitalist is to be asked to become the financial partner or sole owner of the property, an answer may be attempted, but even with these comparatively simple conditions it will be unsatisfactory; for there are no two prospects that are just alike, there are no fixed rules or methods of procedure to be adopted, and circumstances will often point to the most logical course to pursue.

The prospector who finds a cropping containing ore sufficiently rich and of such size as to warrant shipping from grass roots needs to look for neither friends nor capitalists. Such a fortunate individual might more appropriately ask how to protect himself against friends and capitalists, for under such circumstnaces they will be more likely to search for him than to be searched for.

There are several ways of securing money on the supposition that it is to be spent in the making of a mine; some of the ways are as crooked as a worm fence. There are as many ways of selling a hole in the ground—ways that will not stand close inspection, notwithstanding the fact that they are often used and often succeed; but the capitalist of today whom our friend wishes to interest is one who must be shown before he makes an investment. We presume that our correspondent is neither the lucky one who has found a cropping of ore that may be shipped to the reduction works just as broken nor the dishonest one trying to sell a hole in the ground, but a legitimate searcher for ore who has found that which he believes will lead to something of importance.

Our first suggestion to one who has found such a deposit is to let it alone unless he has the courage of his convictions, unless he is willing to put in his own time on it and is willing to sweat blood in demonstrating that it is worth development. Unless he is willing to do this, and does do it, he had better not waste time setting his stakes, for the prospector of today is up against it unless he has something of real interest to show. In earlier days, when rich finds were more frequent, neighboring claims with small exposures and little work done could often be sold or financed upon the strength of adjoining property; but conditions have changed, and the finds of the prospector of today are often far from any rich neighbor, where they must stand entirely upon their own merits, and without some commercial ore in sight or excellent indications of finding it, they will not be eagerly taken up.

Having found something that is worth good hard work, our suggestion is to start that work at once at the most promising point where conditions permit and stick at it until it is impossible to go farther with the means at hand. Do not attempt to stake the whole country or cover the whole district, if a new one, with your claims. If you have been the first on the ground and have taken the best, leave some for the other fellow; let him have something to work on. If he strikes pay he won't hurt you, and his finding ore under a less favorably disposed surface may even help you. A large number of claims, if honestly held, means scattered and ineffective work, while a small number well located permits of the assessment work being concentrated at one or two points and the effective accomplishment of results.

If your circumstances permit, do not stop when the annual assessment work is done, but keep digging as long as you can and then put in another round just for luck; don't stop until you have ore in the bottom or ore in face. No matter how hopeful you may be, no matter how much interest you are ready to give up, a barren or hungry face will attract little attention. Scattered work over a large number of prospects makes a bad impression. It appears as though you had looked about everywhere for an oreshoot and had failed to find it. One shaft with something in the bottom is worth a dozen holes in leached vein matter.

If you find something on the surface or underground, stick to it no matter where it leads or how crooked a hole it makes; follow the high-grade streak wherever it leads. Remember that you are prospecting—not mining. Your business is not to open the ground for economical mining, but to make the most extensive opening possible upon ore.

Let your capitalist sink the vertical working shaft or run the long crosscut to reach your ore at greater depth. Many a good prospect lies idle today, not for lack of work done, but because the work was wasted on excavations that never reached the oreshoot.

Having done good honest work, all that you could afford to do, and having found nothing but perhaps a still deeper belief in the merits of your find, we are at a loss for a method of securing capital. On the other hand, if you have found commercial ore and continue to find it as you sink or drive, the chances are that you will not have to seek capital; a real find advertises itself, and sooner or later one or more scouts from the many substantial mining organizations operating all over the United States will reach you.

Should the scout not appear, because of your isolation, he or his employees may be reached by means of the addresses published in the professional directory in the *Engineering and Mining Journal*. Write a plain straightforward letter telling what you have found. Do not exaggerate; stick to facts, and let theories alone. If the first one turns you down, try again. If you have something that is worth while and you are able to tell what you have, you will find someone who will be interested.

BY THE WAY

Cananea is probably the most prosperous camp in Mexico today. There are more people in this community than ever before, and many who have jobs are supporting others who have found no other means of keeping from starving. The Cananea Consolidated Copper Co. is running full blast and is employing more Mexicans than ever in its history. Instead of paying them in paper currency worth about 1c. on the dollar, this company is paying its employees in coin, and there is more satisfaction and prosperity for Mexicans in this Americo-Mexican community than in any other part of their country. Many other places would be sharing in this unbounded prosperity if Mexico's house were in order. There is much talk of late that the foreigner will no longer be permitted to exploit Mexico's resources. If the foreigner does not supply the money required for developing these enterprises, who will? Mexico has been sucked dry by its bandits, politicians and generals, and such capital for the most part dares not return. The rank and file of the Mexicans will yet learn that the Gringo is their best friend, and before long they will be courting him to come back and bring his regular paydays and good times.

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After standing trial twice for using the mails to defraud, Albert W. Freeman, promoter of the Hawthorne silver- and iron-mining ventures, pleaded guilty before Federal Judge Augustus N. Hand on Dec. 20 and was fined $3,000. Freeman was first convicted in March, 1912, with Julian Hawthorne and Dr. William G. Morton, for using the mails in the sale of the mining stock. Hawthorne and Morton served a year in the Atlanta prison, but Freeman, who was sentenced to five years, took an appeal and won it. "I only impose this sentence," said Judge Hand, "because the Government has consented to it and because after years have passed and two trials have been held, a jury was loath to convict. I do not, however, consider this sentence adequate punishment, Mr. Freeman, for what you have done. In these indictments there is clear proof that representations were made to the public which purchased those stocks that the money would go into the properties and no commissions would be paid, as would have been necessary if the propositions had been underwritten in Wall Street. As a matter of fact, you had an underwriting agreement which provided on its face that you would be paid a large part of the money received as commissions. I think that under the circumstances it was a very aggravated case, and I cannot understand why the jury did not convict." Freeman seemed not to be affected by the judge's words and stepping forward briskly, peeled the amount of the fines from a roll of thousand-dollar bills and handed the money to Court Clerk Westervelt.

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A new member of the Toronto Standard Stock Exchange was recently subjected to the ceremony of initiation, which, as administered by that body, not only furnishes a source of innocent merriment to the sportively inclined, but imparts to the neophyte a highly useful lesson. The victim received a telephone call from "Dr. Drinkwater" instructing him to sell 1,000 shares of "Continental Porcupine," a purely fictitious stock, at 15c. The sale was speedily effected, and other transactions in the stock followed during which the price steadily rose. Then came another call from Dr. Drinkwater, asking the broker if he had bought the shares according to instructions. The broker insisted that the order was a selling one, the supposed client growing exceedingly indignant and insisting on having the stock, which in the meantime had been bid up to 40c. After the new man had been sufficiently impressed with the seriousness of the situation and the fact that he was up against a loss of several hundred dollars, all transactions in Continental were called off, the stock removed from the list and the victim informed that he was a duly initiated member and cautioned about doing business with unknown parties over the 'phone.

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J. Parke Channing is one of our great mine operators who is intensely interested in the welfare of the men that work under his direction and who does for them with his right hand a lot of things that his left hand does not know. When Mr. Channing was a young man, engaged in iron mining in Michigan, a town in northern Michigan was named for him, an honor in which he has always felt a proper and pardonable pride, and naturally a great interest in the town. He has lately signalized this by giving to the railroad men of Channing a clubhouse. Speaking of this, the *Daily Mining Gazette*, of Houghton, Mich., makes the following graceful remarks: "Channing, a junction point, needs just such a building to serve just such a purpose as Mr. Channing plans. We call attention to this act by Mr. Channing because he is today a man of prominence and a man of wealth. He came here to the Copper Country from college and in his youth worked in our copper mines and in our iron mines. His great successes came afterward. Now he is looking about to do good things for his fellow men. And he remembers the towns of upper Michigan. Naturally he remembers the little town that was named in his honor. And, naturally, for him, he decided that a sensible practicable proposition like a good clubhouse would be more fitting than a monument done in bronze or iron or copper. Mr. Channing's act is all the more to be commended because of the fact that the Copper Country has graduated any god's number of millionaires, most of whom promptly forgot their old Copper Country and few of whom ever once think of remembering the old town of their origin or the beginning of their wealth."

Personals

Will L. Clark was in New York for a short visit.

J. T. Young has removed to Stoddard, Ariz., from Metcalf.

John Gross is at Georgetown, Colo., on professional business.

E. W. Westervelt has changed his address from Ludwig, Nev., to 1545 St. Paul St., Rochester, N. Y.

F. C. Schrader, of the Geological Survey, has returned from geological work in Nevada and New Mexico.

Arthur P. Watt, metallurgist for the St. Louis Smelting and Refining Co., at Saint Francois, Mo., is in New York.

E. W. McMurray has been retained as general superintendent of the Rambler property, at New Albany, Wyoming.

Dorchester Mapes has been appointed general manager for the Rambler Copper and Platinum Co., New Albany, Wyoming.

J. L. Mauch formerly with Repath & Mac Gregor, Douglas, Ariz., as chief draftsman, has been in New York recently.

E. J. Wallis will become manager of the Pacific Coast district of the Western Electric Co., with headquarters at San Francisco.

William Spence Black has been placed in charge of the Ajax mine, Victor, Colo., which has been taken over by the Carolina Co.

Julius Thielman, president of the Rambler Copper and Platinum Co., has retired from the active management of the company.

C. A. Filteau has resigned as manager of the St. Lawrence Talc Co. to take the management of the National Mines, Ltd., Cobalt, Ont.

Dr. H. M. Payne has returned from a business trip to the Pacific Coast and expects to be in New York until the middle of January.

R. W. Pack, of the Geological Survey, has returned to Washington after an extensive study of the geology of the oil fields of California.

A. T. Drysdale has been appointed superintendent of the Birmingham, Ala., plant of the United States Cast-Iron Pipe and Foundry Co.

A. E. Wells, who was in New York before the holidays, has returned to Salt Lake City, where he will take charge of the Bureau of Mines Station.

D. M. Liddell, consulting engineer for Merrill Lynch & Co., of Wall St., will leave for the middle west New Year's day on a short professional trip.

James H. Spencer, of Spencer & Waters, Santiago, Chile, is in New York for a stay of about two months. His address will be in care of Remington-U. M. C. Co., Woolworth Building.

George B. Butterworth sailed on Wednesday, Dec. 27, from New York for Venezuela, where he will undertake the management of the South American Copper Syndicate, operating at Aroa.

Howland Bancroft has returned to the United States after an extended absence in Bolivia and Chile. He will be at the Engineers' Club, New York, during January, after which he will return to Denver.

George F. Kunz addressed a meeting of the American Association for the Advancement of Science, at New York, Dec. 26, at the School of Mines, Columbia University, on the subject of "Preparedness."

E. H. Webb has resigned as superintendent for the Pittsburgh Crucible Steel Co., and undertook his new duties as superintendent of the Virginia Iron, Coal and Coke Co.'s blast furnaces, at Roanoke, Va., on Dec. 15.

Dr. George H. Ashley, a geologist in the service of the U. S. Geological Survey, has been granted a leave of absence to occupy the chair of geology in Vanderbilt University at Nashville, Tenn., during the absence of Prof. L. C. Glenn. Professor Glenn is engaged in private work but has not resigned his position at Vanderbilt, which he may resume next year.

Obituary

Williard Gray, M. P. for London since 1915, when he was elected by acclamation following the death of Major Beattie, died at London, Ont., Dec. 12, 1916, following a long illness from Bright's disease. He was 54 years of age. He was born in Newcastle, Ont. He had held many offices of trust in the conservative party in London, and had a reputation as a most successful worker. He leaves a wife and one son. Mr. Gray was president of the Dominion Oil Co., president of the Maple Leaf Oil Co., of Coalinga, Calif., and was connected with a number of other concerns.

John Roberts Mitchell, a mining engineer well known and highly respected throughout the West, was attacked by heart disease while examining mining property in Arizona, and just lived to reach his home in Denver, where he expired on Dec. 16, 1916. Mr. Mitchell was born in Cornwall, England, in 1856, had considerable experience in diamond mining in South Africa but has been in America for the last 35 years. His most notable positions were: Superintendent of the Dolores mine, Chihuahua, Mexico, and superintendent of "Alaska Gold," then known as the Alaska Perseverence. The latter mine was developed by Mr. Mitchell, who erected the Perseverence mill and profitably treated the ores for several years. Mr. Mitchell is survived by a wife and son, a brother in Rhodesia and by two sisters.

Societies

Northwest Mining Association will hold its convention in Spokane, Wash., on Feb. 19 to 25, 1917. This will be an important event for the mining men of the Northwest, many coming from the Northwestern States and from British Columbia and Alaska.

The Faraday Society—At the 80th meeting of the Faraday Society held in London on Nov. 8, 1916, the general subject of refractory materials was considered. Dr. J. W. Mellor spoke on the subject of "The Texture of Firebricks." Prof. W. G. Fearnsides on "The Application of Petrographic Methods to the Study of Refractory Materials." Dr. P. G. H. Boswell read a paper on "Refractory Sands." Several other papers relative to the subject were read also.

The Colorado Metal Mining Association will hold its annual meeting at Denver, Jan. 9, 10, 11 and 12, 1917. At that time a meeting of the tungsten producers of the United States will be called for the purpose of formulating a definite plan for concerted action in all matters affecting the industry, and particularly to unite in an effort to secure as early as possible favorable action on the part of the proposed tariff commission in behalf of a duty on tungsten ores and its products.

American Institute of Mining Engineers, Utah Section, held their annual meeting at the Utah Hotel, Salt Lake City. The officers elected for the ensuing year were: Chairman, C. W. Whitley; vice-chairman, William Wraith, and secretary-treasurer, Ernest Gayford. Papers by J. M. Callow, entitled "Notes on Flotation, 1916," and by Irwin Wilke, entitled "The Manufacture and Use of Sulphuric Acid" were presented. An address was also made by Major Westly King on "Military Conditions on the Mexican Border." Attendance at the meeting reached about 100 members and guests.

University of Illinois—The senior mining engineering students, under the direction of Professors H. H. Stoek and E. A. Holbrook, have completed their annual inspection trip. This year the trip included an inspection of the State Mine Rescue Station at Springfield, Ill., the lead smeltery at Collinsville, Ill., and the Laclede byproduct coking plant at St. Louis Mo. From here the party established headquarters in Flat River, Mo., and spent several days visiting the lead mines and mills in the district. A side trip was made to the old "Mine La Motte," which is being rejuvenated by modern methods. Afterward several of the large coal mines in southern Illinois were inspected.

Geological Society of America—At the Albany meeting of this society George Otis Smith, Director of the U. S. Geological Survey, said that geologists who accept professional work involving appearances before courts in favor of a litigant are in danger of lowering the scientific standard of their profession. Dr. Smith predicted that the day is not far distant when the court will summon its own expert witnesses and compensate them for telling the whole truth and not that part of the truth which favors one party to a suit. Dr. Smith's subject was "Geology and Public Service." He appealed to geologists as a professional class, not only to make their science more human but to humanize themselves. He declared it to be his belief that the geologist is well qualified by special training to serve society, not only as a professional adviser, but to take a larger part as a citizen.

American Association for the Advancement of Science held two joint meetings at New York during Christmas week with the American Electrochemical Society, one on Dec. 27, and another on Dec. 28. The first meeting was for the consideration of a symposium on "The Structure of Matter," at which several well-known authorities explained their views. At the meeting of the second day various subjects were discussed. On Friday evening, Dec. 29, the engineering section of the society held a meeting by invitation of the American Society of Civil Engineers, American Institute of Mining Engineers, American Society of Mechanical Engineers, and the American Institute of Electrical Engineers at the United Engineering Societies Building. The subject discussed was the relation now existing and that which should exist between men of pure science and their brothers of the engineering professions.

Michigan College of Mines—Manager E. W. Walker, of the Mass Consolidated Mining Co., president of the Alumni Association of the Michigan College of Mines, yesterday gave out the list of nominees reported to him recently by the nominating committee of the association. These nominees probably will be elected at the coming annual meeting. They are: President, W. H. Schacht, assistant to the general manager, Copper Range Co., Painesdale, Mich.; vice-president, John Knox, general superintendent, Calumet & Hecla companies, Calumet; treasurer, H. T. Mercer, chief engineer Champion Copper Co., Painesdale; secretary, James Fisher, professor of mathematics, Michigan College of Mines, Houghton. Members of the board of managers, John L. Harris, general manager, Hancock Consolidated Co., Hancock; A. H. Floeter, chief engineer, Mohawk and Wolverine companies, Kearsarge; W. B. Pattison, general superintendent Breitung-Kaufman mines, Negaunee; S. Russell Smith, superintendent, Ahmeek mine, Ahmeek.

Industrial News

Venegas F. Aguiles, School of Engineering, Lima, Peru, requests catalogs of mining and milling machinery. These should be addressed to him as above.

The Layne & Bowler Corporation, of Los Angeles, recently supplied an electrically driven sinking pump, on a hurry order, for the Tom Reed Gold Mines Co., at Oatman, Ariz.

Wood Drill Works, of Paterson, N. J., has just placed a new self-rotating hammer drill on the market. The drill automatically cleans the hole. If by chance the air going through the steel is not enough to clean the hole by pressing down on the button at the top of the chest the full pressure of air is directed to the drill point, cleaning the hole of all cuttings at once. By releasing the button, the drill starts automatically. One of the advantages claimed for this drill is the absence of piston breakage, and another is, that no collars are required on the steels, eliminating a great deal of the blacksmith trouble and expense. The steel only requires to be cut off squarely and tempered and pushed up against the anvil block of the drill.

Trade Catalogs

Portable Electric Drills, Reamers, Grinders. The Van Dorn Electric Tool Co., Cleveland, Ohio. Catalog. Pp. 50; 3½x8½ in.; illustrated.

Storage Battery Trucks. The Jeffrey Mfg. Co., 974 N. Fourth St., Columbus, Ohio. Bulletin No. 200. Pp. 8; 6x9 in.; illustrated.

Giant Fuel Oil Engines. Chicago Pneumatic Tool Co., Fisher Building, Chicago, Ill. Bulletin 34-W. Pp. 28; 6x9 in.; illustrated.

Jeffrey Armaster and Solenoid Switch. The Jeffrey Mfg. Co., 974 N. Fourth St., Columbus, Ohio. Bulletin No. 204. Pp. 4; 6x9 in.; illustrated. Describes new devices designed to eliminate the burning of contact fingers and arc deflectors of the controller.

Boyer Railway Speed Recorder. Chicago Pneumatic Tool Co., Fisher Building, Chicago, Ill. Bulletin No. 263. Pp. 28; 6x9 in.; illustrated.

Assessments

Company	Delinq.	Sale	Amt.
Alta T. & Trans., Utah	Jan. 6	Jan. 25	$0.01
Atlantic, Ida	Dec. 9	Jan. 9	0.001
Blue Point M. & M., Utah	Jan. 2	Jan. 15	0.0025
Bullion, Nev	Jan. 8	Jan. 30	0.02
Caledonia, Nev	Jan. 9	Feb. 3	0.05
Carbonate Keystone, Utah	Dec. 14	Jan. 2	0.01
Century Gold, Utah	Dec. 10	Jan. 10	0.01
Eagle Mtn., Ida	Dec. 22	.....	0.001
East Hercules Ext., Ida	Jan. 2	Feb. 2	0.0005
Ely-Gibraltar, Nev	Dec. 15	Jan. 10	0.0025
Emerald, Utah	Dec. 15	Jan. 13	0.001
Eureka, Ida	Dec. 9	Jan. 9	0.001
Four Timbers, Ida	Dec. 2	Jan. 2	0.002
Hector, Ida	Dec. 22	Jan. 16	0.005
Idaho & Los Angeles, Ida	Jan. 12	Feb. 9	0.005
Imlay, Nev	Dec. 19	Jan. 9	0.01
Independent, Ida	Jan. 13	Feb. 13	0.01
Iron King, Ida	Dec. 9	Jan. 9	0.001
Mayflower, Ida	Dec. 23	Jan. 25	0.005
Nevada Stewart, Ida	Jan. 8	Feb. 8	0.003
New Hope, Ida	Dec. 11	Jan. 11	0.002
North Franklin, Ida	Dec. 30	Jan. 22	0.005
O.K. Extension, Utah	Dec. 21	Jan. 10	0.0025
Old Veteran, Ida	Jan. 6	Jan. 27	0.002
Ophir, Nev	Jan. 9	Jan. 30	0.05
Potosi, Nev	Jan. 8	Jan. 31	0.02
Rarus M. & S., Utah	Dec. 16	Jan. 4	0.00075
Reindeer Queen, Ida	Dec. 16	Jan. 22	0.005
Savage, Nev	Jan. 5	Jan. 29	0.02
Secret M. & M., Utah	Dec. 21	Jan. 10	0.0075
Sierra Nevada, Nev	Jan. 4	Jan. 25	0.10
Silver Dollar, Utah	Dec. 31	Jan. 15	0.0005
Silver Pick, Nev	Dec. 2	Jan. 8	0.02
Slavonian, Ida	Dec. 30	Jan. 20	0.001
Southwestern Miami, Ariz	Jan. 11	.....	0.50
Tarbox, Mont	Dec. 22	Jan. 13	0.005
Tiberius, Ida	Dec. 21	Jan. 12	0.00075
Utah Bellevue, Utah	Dec. 15	Jan. 6	0.001
Uvada, Nev	Jan. 6	Jan. 22	0.02
Wallace M., M. & R., Ida	Dec. 8	Jan. 8	0.0025
West Dip, Nev	Dec 24	Feb. 13	0.005

The publication of this table will be discontinued after Dec. 30, 1916.

Editorial Correspondence

SAN FRANCISCO—Dec. 22

Transportation for the Darwin District may be improved. The Darwin Development Co. has made a preliminary survey between Darwin and Keeler. It was found that the distance of about 26 mi. by wagon road must be increased in order to secure a 5% maximum grade over which an industrial railroad may be economically operated. It is believed that such grade can be secured in a distance of 32 mi. The entire district has developed rapidly in the past year and a number of mines would be enabled to make much more advancement toward profitable commercial production with the advantage of shipping facilities that could be provided by a small railroad system. But the Darwin Development Co. is the only operator and owner having a production warranting an interest in such an undertaking. Many of the silver-lead and copper ores of the district could be shipped with economic transportation rates. It would thus be profitable to mine on a small scale and give to the small owner and leaser a chance for development looking to larger production. The Darwin Development Co. has not announced intention of undertaking the railroad construction, but has been gathering data on this subject through its consulting engineer, F. W. Weekes, and C. L. Ray, chief engineer of the company.

Ventilation in Metal Mines is discussed in Bulletin 3, issued by the State Industrial Accident Commission. Suggestions are offered regarding the prevention or overcoming of difficulties that are often encountered. Results of poor ventilation coming under the notice of the U. S. Bureau of Mines are discussed, and one case is cited of a mine that produced approximately 1,000 tons of ore per day at a cost of $1,000. The labor cost was about $750. On account of poor air and heat in one part of the mine it was estimated that miners put in only one-half of their time in effective work, producing 300 tons, where 600 tons could have been extracted had conditions been normal, or increasing the total to 1,300 tons per day, and reducing the labor cost from 75c. to 57.7c. per ton. Numerous cases were noted where muckers were overcome by powder gases from the muck pile. In several large mines it was noted that in opening new levels, drifts were run as far as 1,000 ft. before raising to the level above. The causes of vitiation and pollution of mine air, effect of impure air on men, and heat and humidity are also discussed. Natural and mechanical ventilation of dead ends are also presented briefly and suggestions offered as to best method of ventilation. The bulletin may be secured without cost by application to the commission at 525 Market St., San Francisco.

Coöperative Mine-Safety Work of the State Industrial Accident Commission and the U. S. Bureau of Mines will continue under the direction of H. M. Wolfiin, who will act as mining engineer for the Bureau of Mines and as chief mine inspector for the Industrial Accident Commission. The arrangement being practically the same as that under which Mr. Wolfiin's predecessor, Edwin Higgins, had been working, with the exception that it is understood that more time is to be spent on investigative work than has been possible in the past. The mine-safety work in California has grown to large proportions and at the close of 1916 it appears to be doubtful if the work of inspection can be adequately carried on by the present force. It is not improbable that the services of an additional inspector may be required next year. The appointments are made from the eligible list of state civil-service men who passed the examination of two years ago. At that time it evidently was not foreseen that should a vacancy occur in the position of chief inspector, such vacancy might not be easily filled from the eligible list of metal-mining engineers. This condition arose upon the resignation of Mr. Higgins at the end of October and had not Mr. Wolfiin been desirous of returning to California, there could have been no satisfactory appointment under the rule which governed at the initial organization of the coöperative work. The complete and satisfactory organization of the mine-safety work of the Industrial Accident Commission in coöperation with the Bureau of Mines, will not be accomplished until there is provided a system of examination that will make mining engineers, who successfully pass the examination for the position of inspector, eligible to the position of chief mine inspector. The state civil-service examination now reaches only to the point of capability for the position of inspector in the field. It would be an easy matter and an effective plan to make two grades: The position of inspector in the field and an advanced grade which places the man who stands highest in the active list of inspectors employed, eligible to the position of chief mine inspector. If some such method as this be carried out, it will not only satisfy the mine owners that they will not be subject to unsatisfactory changes in the personnel of the department, but will give the field men an incentive to more ambitious effort. And it will take the method of appointment entirely out of any possible contact with, or submission to, political influence.

DENVER—Dec. 21

Rockfall at Independence Mine about midnight on Dec. 12 was for some time thought to be an earthquake but Victor residents learned the next day that it was only a heavy rockfall in one of the oldest workings of the Independence. Nobody was injured.

Tungsten Reduction Works have been under consideration for some time by the independent milling companies, such as the Rare Metals Ore Co., operating at Rollinsville, and the Boulder Tungsten Production Co., at Stevens. These concerns hope to have reduction departments in commission before long and to produce commercial forms of tungsten and its compounds. The camps of Nederland, Lakewood and Stevens are active, although they have dropped the feverish activity of a year ago.

Labor Strike at Leadville is believed to be indefinitely postponed by recent action of the principal mine operators who have granted the following wages, effective Dec. 1: Men heretofore receiving $3.30 will now receive $3.50; those formerly paid $3.85 will now earn $4; while men who have been paid $4.40 will now receive $4.50. This is not a uniform advance but it is really a raise of 50c. over the wages that prevailed prior to last April when a uniform advance of 10% was made owing to the high price of spelter.

Smuggler Mine at Aspen which produced fabulously rich ore in the nineties—ranking in fame with its neighbor, the Mollie Gibson—has been afire for years. Orebodies of the district are in a carbonaceous, shaly limestone that fires spontaneously. All efforts to suppress this fire have failed and for years past operations in the mine have been conducted at great handicap. The heat in the workings has been intense. Two weeks ago miners on the 1,800 level unwittingly tapped a strong water course that quickly flooded the workings, the men barely escaping with their lives. The electric mine pumps were promptly drowned. Manager Anderson of the company that leases the mine looks upon the accident as a disguised blessing and is content to permit the workings to remain flooded long enough to completely extinguish the fire before he attempts unwatering.

"Dividends" is the glad word among mine owners this holiday season. Disbursements that have been declared by Colorado companies are too numerous to give a complete list but among the important ones were the Portland at Victor and the Yak at Leadville. Beside the regular 3% quarterly disbursements by the Portland company, there was recently issued an extra dividend of 2%. The year's profits to stockholders amounted to $420,000 and all of this was paid out of earnings that accrued prior to March, 1915. The Yak Mining, Milling and Tunnel Co.—of which some of the principal stockholders are Walter W. Davis, Harry C. James, John C. Mitchell, Myron T. Herrick and the estate of James B. Grant—has, in addition to its regular quaterly dividends of 7%, declared a Christmas present to its owners of a round 50%. The company being capitalized at $1,000,000, the year's distribution amounts to $780,000. The bulk of this extra dividend was made possible by the action of Manager Davis in withholding his silver bullion from the market until the price reached the recent high points.

Radium Is Being Produced in Denver by the Schlesinger Radium Co., using a secret process that is said to be superior to that developed by officials of the U. S. Bureau of Mines and publicly announced last winter. Several former attaches of the Federal bureau are connected with the new company which has office and laboratory at 2001 East Colfax Ave. in the Capitol Hill residence section; the works are at 1045 Tejon St. on the west side, convenient to railroad trackage. The laboratory site was selected with the object of securing as great isolation as possible from vibrations and other disturbing influences that prevail in the manufacturing part of the city. The building has three stories, each with a particular department. Although company is not fully under way, the production of radium averages, at present, about $1,000 worth per day. The U. S. Government is reported as owning 560 mg. of radium bromide that was manufactured in its Denver plant prior to its sale to the Pittsburgh Radium Co. The Government has deposited its radium material at the School of Mines in Golden, the new home of the Colorado branch of the bureau.

BUTTE—Dec. 22

Tuolumne's Discovery in its Main Range property continues to be the mining sensation in Butte. Total width of vein formation is given at 132 ft. and about 50 tons per day is being taken out in the development work on the 700 level.

Natural Gas Fuel for Anaconda Smelteries is in prospect. According to report, Anaconda has acquired control of the Montana Canadian Oil Co., owning a large producing well near the international boundary and will pipe this gas to Great Falls and Anaconda for use in its reduction plants, as well as for domestic purposes. The gas, it is stated, will first be piped to Great Falls—about 75 mi.—and is expected to make an important saving in fuel expense for that plant. Several hundred miles of piping will be required if the project to carry the pipe lines to Anaconda and Butte is carried out.

Fourth Section of Zinc Refinery at Great Falls will not be started until about Jan. 1 and the fifth section about two weeks later; this change of dates in starting was caused by delay in the receipt of electrical equipment for the substation. The three sections that are now in operation are doing better work than was anticipated. Last Saturday, Dec. 16, 95 tons of zinc were made in the three sections, a record-breaking day so far. This 190,000 lb. of the superior electrolytic brand is bringing a good premium over the regular price of ordinary spelter. When the plant was planned, it was anticipated that its capacity would not exceed with all five sections running, 6,000,000 lb. of zinc per month or 72,000,000 lb. per year. Saturday's output was at the rate of over 100,000,000 lb. per year.

Mineral Output of Montana was valued, in the annual report of State Mine Inspector W. B. Orem at $141,000,000 for this year, an increase of $51,852,862 over 1915. "Without the slightest desire to belittle any other industry," says the report, "it is of interest to note that mining tops any other two industries combined in Montana. Figures show that the value of the mineral output for 1916 exceeds that of farming and stock-raising combined by $30,000,000. The Butte district alone, with its less than four square miles, produces more in mineral value than all the farm lands of the huge state combined, produce. The mines, mills and smelteries of Montana, not including the coal mines, give direct employment to 28,000 persons, the highest paid laborers in the world. Two-thirds of the state's output comes from the Butte district." Commenting on the old prejudice that existed in former years in the rural district against Butte and the mining industry, the report says: "It used to be argued by the residents of the cow counties that the big mining companies dug out the metals, sold them and sent all the proceeds East to enrich wealthy stockholders. Such is a long way from the truth. The facts are that for every three dollars taken from the ground in Montana in the form of mineral wealth, two dollars remain in the state and from $50,000,000 to $100,000,000 are paid out by the mining companies of Montana each year for labor and supplies. The mining centers of Montana are the greatest consuming districts. The City of Butte alone with its 100,000 inhabitants consumes as much as other cities of double that size. Hay, grain, fruits, meats, dairy products pour into Butte in wholesale quantities from the Montana farms and valleys." The report states that 18,500 men work in and around the mines of the Butte district and of this number 14,500 work underground and 4,000 in the mills and on the surface. The payrolls for the year averaged over $2,000,000 per month for the men employed in the mines alone. This does not include the payrolls at the reduction works in Anaconda and Great Falls.

Growth of the Zinc Industry in Montana is touched upon in Mr. Orem's report as follows: "The amazing growth of the zinc industry in Montana in recent years is such as to require special mention. The zinc output in 1915 amounted to 10,500,000 tons of ores and in 1916, 26,000,000 tons. Copper has been the major industry in the state for years and still is, but zinc is coming fast and may yet rival copper. The principal feature that has boosted the zinc industry in Montana is the new method of treating the different ores. From the showing of the last year, Montana will yet be the largest producer of zinc in the United States. During the fall of the year 1915, the Anaconda company started the mining of zinc ores, the actual hoisting of which however was not well under way until the year 1916. The principal mines now being worked for zinc ores are the Poulin, Lexington, Alice, East Colusa, and the Emma. Besides these zinc ore will be mined in the Gray Rock, Badger State, Pilot Butte, Moonlight, Original, Belmont and High Ore mines.

During the first nine months of the year 1916, only 50% of the zinc ore hoisted was treated at the small plant at Anaconda. The remainder was stacked up on the surface at the mines. The shipment of these stock piles was started in October when the zinc concentrator at Anaconda and the electrolytic zinc plant at Great Falls were put into commission. At present there are 725 men employed by the Anaconda Copper Mining Co. in the mining and development of zinc ore. This number will be greatly increased during the coming year. Ground was broken for the Great Falls electrolytic zinc plant in December, 1915. The first unit was put into operation early in September. The zinc produced is extremely pure and assays 99.95% zinc. The plant when operating at capacity will use 35,000 hp."

SALT LAKE CITY—Dec. 22

Enlargement of Garfield Smeltery—practically doubling the capacity—will, it is expected, be completed during the autumn of 1917. The capacity is to be 6,000 tons of ore daily, as compared to an original capacity of 2,500 tons, already somewhat increased. Power line facilities needed for the operation of the enlarged plant are being added to. For the use of its working force—numbering approximately 1,500—the company is building a large central bath house, with lockers, etc., provided free of charge. A community refrigerating plant for employees also is to be built.

Utah Leasing Co., which is meeting the problem of the treatment of the low-grade dumps of the old Cactus mine at Newhouse in Beaver County, expects to have the capacity of its mill increased to 850 tons daily by the middle of February. The plant began operation a little over a year ago and has been treating 600 tons a day. There are about 1,000,000 tons of ore on the Cactus dumps and at the rate of 850 tons daily, this ore will furnish material for the mill over a period of at least four years. The dumps carry about 0.7% copper. The saving so far made is stated to have been satisfactory to the company, and it is thought the new equipment and added capacity will make possible a better extraction and larger profit. Flotation is used.

Starting of Pacific Mill in American Fork Cañon—instrumental in bringing better power facilities to the district—marks important progress for the mines in the cañon. The Utah Power and Light Co. has extended a power line from its Snake Creek power plant over the divide to the Pacific and Dutchman mines. As well as furnishing power for the new mill, the new line will provide electricity for driving compressors at various other properties in the district. The Pacific mill itself—built by the Fissures Exploration Co., lessees—with a rated capacity of 50 tons daily, which can be easily raised to 75 tons, will materially increase shipments from the cañon. The Pacific mine is the largest shipper there, and recently marketed two cars of ore running well in copper and silver, from operations carried on by the Fissures Exploration Co. A short time ago an initial dividend of $8,000 was paid by the Pacific mine from royalties.

Dividends from Utah Mines in 1916, amounting to $24,404,430, show an increase of almost $14,000,000 over 1915, which with $10,025,000 held the record in a period of fifty years. Twenty-one names helped to make up the total in 1916. There are five new names in the list of mines beginning payments this year and the last. The Cardiff operating in Big Cottonwood Cañon paid an initial dividend of $125,000 last year, and this year, $375,000. The Lakeview Mining, beginning work last year on Promontory Point, not far from Ogden, paid $59,000 in 1915, and $65,000 this year, chiefly from zinc ore, and some lead. The South Hecla at Alta in Little Cottonwood Cañon made its first payment this year, amounting to $39,525. The Pacific Gold a short time ago paid $8,000, its first payment. The Utah Metal and Tunnel at Bingham, opening a large new body of ore and consolidating with the Bingham-New Haven—a familiar name on the list—in August of 1916 paid $342,470. The entire list comprises the Cardiff, Centennial-Eureka, Chief Consolidated, Eagle & Blue Bell, Eureka Hill, Gemini, Grand Central, Iron Blossom, Horn Silver, Judge, Lakeview, May Day, Mammoth, Pacific Gold, Silver King Coalition, Silver King Consolidated, South Hecla, Utah Consolidated, Utah Apex, Utah Metal and Tunnel, and Utah Copper.

WALLACE, IDAHO—Dec. 21

Tungsten Resources of the Coeur d'Alene have been studied for certain interests for about a year and a half by Chester T. Kennan, a mining engineer of Colorado, who took up his residence in Murray about the time the tungsten excitement was at its height and manifested much interest in that metal, which is found as scheelite in conjunction with the gold ores of the North Side. There is probably not a gold prospect within a radius of 10 mi. of Murray that he has not visited and thoroughly inspected. His investigations have been followed by the purchase of a large group of claims on both sides of Trail Creek and a considerable number of men are now employed in preliminary work upon them. Mr. Kennan is still negotiating for additional property, and for that reason declines to outline his ultimate plans. The property he has acquired has been held for years for its gold content, but it is believed that Mr. Kennan has also found the tungsten content interesting. Associated with Mr. Kennan are E. J. Roberts, of Spokane, and mining men of Salt Lake City and Denver.

GOODSPRINGS, NEV.—Dec. 20

Important Zinc Discoveries have been made this year in the Yellow Pine district in the Root and the Sultan mines, and at the north end of the property of the Yellow Pine Mining Co., a new zone was opened disclosing important orebodies. The Bullion mine in this camp was sold to a Salt Lake syndicate for $50,000 by Yount & Fayle. Among other new companies now operating in the district are the Yellow Pine Extension, Dawn Mining Co., Bill Nye Mining Co., etc. In the copper-gold-platinum section, the Boss mine opened new and larger orebodies, and the Oro Amigo has discovered ore similar to that of the Boss mine.

HOUGHTON, MICH.—Dec. 23

Franklin's Increased Production is expected to reach its high mark by about Mar. 1, when the company's output is planned to be 1,300 or 1,400 tons of rock per day from the Allouez conglomerate. This will be an increase of approximately one-third, as the mine now is averaging nearly 1,000 tons daily. Franklin's increase in rock output will result in a corresponding decrease in cost per ton because of greater efficiency underground. The management has established two economies that other mines are likely to copy. One is the scheme of running as many as eight machine drills in a row, all supervised by one expert. Another is a method of handling foot-wall rock first and "caving" the hanging. The latter is not new, except as applied to Franklin, but it works out admirably as regards this peculiar formation—the Allouez conglomerate. Another feature of the rock handling is a system of tramming haulage which uses an endless rope. The bunching of machine drills pleases the miners, who like company in their work and it saves on supplies.

ISHPEMING, MICH.—Dec. 23

Shaft Accident caused by crosshead freezing to the guides at the Holmes mine near Ishpeming. Three men were instantly killed and three others seriously injured on Dec. 14, when one of the buckets in the shaft dropped. The six men were going to their work of shaft sinking and stopped at the first level to turn off the air that had been used to blow out powder and gas fumes. When they rang to be lowered again the bucket and crossheads did not move. The upper crosshead had become fast to the runners because of heavy frost. The rope coiled on top until the weight caused the crosshead to become loosened. The bucket then dropped 108 ft. to the bottom of the shaft. The shaft is about completed. Only a few feet remained to be sunk. Drifting is to start soon. It was hoped the work would be finished without an accident, many precautions having been taken to make the work safe. A second crosshead was added two weeks ago, to insure greater safety.

Lake Shipping Season Ended on Dec. 13. From figures already been compiled, the total shipments are indicated to have been 65,116,288 tons—over 15,000,000 tons in excess of the record year of 1913. Few vesselmen, men or mine operators believed that the lake fleet would be able to transport as much as 65,000,000 tons in a single year, but there were some who were optimistic from the outset and believed that that figure could be reached under favorable conditions. The all-rail shipments amounted to about 1,000,000 tons; in 1915 it was 960,000 tons. The shipments by ports for 1916 were as follows: Duluth, 21,837,849; Superior, 12,787,086; Two Harbors, 10,735,852; Ashland, 8,057,813; Marquette, 3,858,092; Escanaba, 7,849,596; total, 65,116,288 tons. Of the total amount moved, about 30,000,000 tons came from the mines of the Oliver Iron Mining Co., the ore subsidiary of the United States Steel Corporation. There is no doubt but that the 1917 shipments will be in excess of this year's movement, as plans are already being made to beat all records next year. The railroads will have more cars; there will be more boats operating; and there will be more ore in stock at the mines. Many new underground and openpit mines are being developed, the advance in the price of iron ore causing a big stimulus. Never before did the outlook for the industry appear more promising.

HIBBING, MINN.—Dec. 21

At Chisholm, orders have been received at the headquarters of the Oliver Iron Mining Co. to proceed with the stripping of the Glen mine and the Burt and Bliss properties (the Hartley mine). The appropriation, which has been allowed by the Steel Corporation, calls for the removal of 1,500,000 cu.yd. of overburden at the Hartley mine and 1,000,000 cu.yd. at the Glen mine. It is the intention to push the work at both these mines so that they will be on the producing list in the spring.

In the Hibbing district, another big stripping job has been started near Carson Lake. This property is known as the Smith mine and it is the intention to be ready to ship ore next season. Another mine that started shipments this year is the Kerr. To haul the ore from this pit it was necessary for the Duluth, Missabe and Northern R.R. to build a trestle over a mile long.

Some sales of iron ore for shipment in 1917 have been made at an advance of $1.30 a ton. This would make the price of Mesabi bessemer $5.50 a ton and Mesabi nonbessemer $4.85 a ton. The companies, which sell their ore, however, will not reap the benefit of the entire increase as the lake rates for transporting ore have been increased about 50c. a ton and other advances must be deducted from the net increase in the price of the ore. A sale of ore amounting to 185,000 tons is reported to have been made at an advance of $1.50 per ton. The advance will be welcomed by the companies some of which have been operating at a loss or nearly so during the lean years they have just passed through, and it will compensate them for the increase of wages they will have to contend with in addition to the increased cost of their supplies and other mining expenses.

Important Change in Lease, pratically amounting to a sale on the installment plan, is being considered by the Higgins estate and the Oliver Iron Mining Co. The Higgins property, which is owned by the heirs of ex-Governor Higgins and his sister, Mrs. Frank Sullivan Smith, is one of the largest estates on the range. It comprises about 770 acres, of which 450 acres are situated between Elba and Biwabik, 120 acres east of Embarrass and 200 acres between Gilbert and Virginia. The Oliver Iron Mining Co. has been drilling this property for about two years preparatory to the readjustment of the lease and it is estimated they have shown up about 70,000,000 tons. The new lease which is about concluded provides for the payment of the lease in installments covering a period of 30 years. There is a rumor that the Steel Corporation intends taking over the Hill iron-ore leases; this has been denied by Corporation officials. The Hill lands are said to contain about 300,000,000 tons of ore.

Opening of Iron Mines, that had been closed for a considerable time, was a feature of the Mesabi operations during the season just closed. The St. James mine, of Aurora, owned by the Corrigan-McKinney interest, was opened the first of the year after an idleness of several years. The Bray mine at Keewatin, originally an openpit property and later opened underground, is now being pumped out preparatory to work this winter. The Inland Steel Co. which took over the old Bessemer No. 3 and Bessemer No. 4 properties, erected a new plant on the latter and are sinking a shaft which is expected to be finished this winter. Another property which is expected to open up this winter is the Gilbert mine at Gilbert. This Oliver property was stripped about seven years ago and then developed further by underground operations. It was closed in 1913 and partly dismantled. It is now proposed to strip an additional 500,000 cu. yd. this winter. The Fayal mine at Eveleth broke its previous high records, this year, its shipments running over 2,000,000 tons. This winter they will remove a large tonnage of lean material to release ore for next summer. The Adams mine also intends to do considerable stripping during the winter. At Biwabik a large additional tonnage of ore is reported part of which lies under the Biwabik dump. At Nashwauk, the Hawkins mine is uncovering considerable ore and the York mine which has been recently opened is doing considerable test-pitting and making other preparations for shipping in the spring.

BRAINERD, MINN.—Dec. 22

Cuyuna Range has had the busiest season in its history. Its oft-spurned manganiferous ores were in strong demand this year, owing to restricted importations. Ever since the opening of the range, there has been much speculation and discussion as to the value of these ores. It was the general consensus of opinion for a long time that they had but little market value. So large a tonnage had too great a percentage of silica and phosphorous, and much, according to the opinions of the investigators, was too low in manganese to make it available for the manufacture of ferromanganese or speigeleisen. On the other hand the manganese content was usually considered a detriment as it spoiled the ore for foundry purposes. The fourth biennial report of the Minnesota State Tax Commission printed several opinions and published the conclusion that most of this ore was not merchantable and of little or no value. However, in the course of the last two years there has been a great change. The war prevented the importation of manganese ores from Europe and at the same time created a demand for iron and steel which had considerable of this element. The price of ferromanganese rose to as high as $200 a ton. The great demand for manganiferous ores and the high price paid have lead to the exploitation of such properties as were available and several stock propositions which were then organized on the range received considerable encouragement. The Cuyuna-Sultana is now active and is preparing to ship 50,000 tons to Chicago by an all-rail route. This property has not been opened up for big production heretofore and slicing is just commencing. The Cuyuna Mille Lacs is also anticipating activity and the Mangan No. 1 in the same vicinity, is working at a good rate and is preparing to stockpile its product. A shaft is being sunk at the Joan

mine. Several of the larger properties have had a satisfactory season. The largest producing properties on the north range have been the Rowe, Thompson, Armour, Croft and Mahnomen. The Croft is the only known mine containing a deposit of bessemer ore on the range. The Rowe mine at Riverton is the largest pit, mining a large deposit of siliceous ore which is treated at its concentrating plant. The Mahnomen mine has been stripped during the last two years and considerable water trouble has delayed operation as the pit is in a low spot. At present two shovels are removing ore. A drainage shaft is being sunk at the Rowe.

JOPLIN—Dec. 23

November Shipments from the Arkansas Field, the statistics of which have just been made available, broke all previous records, with a total of 93 cars aggregating 3,000 tons, estimated valuation $200,000. The Edith mine at Rush and the Big Hurricane at Pindall were the largest individual shippers ,each having 10 cars to its credit. The apportionment to the various camps was as follows: Rush, 18; Buffalo, 12; Zinc, 25; St. Joe, 11; Glibert, 5; Pyatt, 2; Pindall and miscellaneous, 23 cars.

Cold Weather Curtailed Production decidedly in the Joplin district during the last week. Gas pressure was low, and ore froze in bins and elevators. Water froze in the tailing piles and its failure to run back into ponds left many plants short of water for milling purposes. Continued shortage of electric power, preventing mills from being operated straight through the day, increased number of "freeze-ups." A number of plants are substituting steam engines for motors, among these being the Athletic at Duenweg, and the Big Run at Webb City.

Mine Owners Will Operate a Hospital in this district. At meeting of the Southwest Missouri Mine Safety and Sanitation Association on Dec. 21, the members voted to take over the management of the Jane Chinn hospital in Webb City for the coming year. Many operators have been contributors to the upkeep of the institution but in the past it has been managed by a board of trustees. The hospital is a gift to the city by the late Mr. Chinn, as a memorial to his wife. Ownership will remain as provided by the will, but the management will be entirely in the hands of the Safety and Sanitation Association.

WASHINGTON, D. C.—Dec. 23

Placer-Mining Statistics may be no longer collected by the U. S. Geological Survey, owing to indifference on the part of the operators. There are 3,200 names on the Survey's placer-mine list. To the first request for statistical information there were replies from only 19%. Subsequently 1,306 second requests were sent out from which replies were received from 30%. Since the two inquiries received so little attention, it is regarded at the Survey offices as indicating that the placer-mine operators are not interested in data regarding their industry. This is a decided contrast with the conditions among other mining operators. To obtain the data necessary for carrying out the plan of complete placer-mine statistics, it would be necessary for the Survey to go to large expense and take up much of the time of men urgently needed on other work. To get the data by personal visits to the properties from which no returns were made would entail undue expense.

TORONTO—Dec. 23

Flagrant Manipulation of Ontario mining stocks is being practised by certain Canadian houses. One practically worthless property has been boomed to a stock-market value of nearly $1,500,000 on false reports of the grade and amount of ore developed. This state of affairs will work harm to the industry and when the inevitable collapse does come will make it much harder to interest the small investor in legitimate offerings. Several of the pioneers of this new speculative boom, by the wide distribution of flamboyant advertising, and no doubt, by their own efforts in protecting the market, have succeeded in running the stocks up to much higher levels than they should be selling at and have created to some extent a real public demand. Their success has resulted in the incorporation of a number of other companies and the same tactics are being employed to boost the prices of these stocks. This class of stock should be viewed with suspicion as the operators are much more interested in making money out of the public than out of the ground. It is unfortunate that laws cannot be devised that will prevent people from losing their money in foolish speculations; in the present case they have been drawn into a carefully tinseled net of "publicity."

The Nickel Problem has entered upon a new phase and has latterly become almost entirely a party issue. Conservatives, who had formerly been outspoken in favor of drastic measures to control the export of nickel generally profess themselves satisfied with the explanations of the government. Constituents of W. F. Maclean, M. P. for South York, one of the strongest assailants of the government policy, at a representative meeting of the Conservative party passed a resolution endorsing the nickel policy of the Canadian and Ontario governments and expressing disapproval of Maclean's stand on the question. The attack, however, is maintained vigorously by the Liberal press and speakers and a strong point is made of the alleged under-taxation of the Canadian Copper Co., the subsidiary of the International Nickel Co., the profits of which it is contended should be calculated differently. This is all political claptrap, as the International is working in perfect harmony with the British Government.

The Mining News

ARIZONA

Cochise County

PEABODY CONSOLIDATED (Johnson)—Second carload of machinery has arrived and new compressor plant is being set up at No. 2 shaft which is being sunk to extract the sulphide ore. Property opened many years ago but up to present has shipped only oxidized ores.

COPPER QUEEN EXTENSION MINING CO. (Bisbee)—This company has succeeded the Bisbee West. Incorporated by James Letson, of Bisbee, Thomas Higgins and D. F. McGary, of Los Angeles. Controls 440 acres west and southwest of Don Luis. On the ground are two old shafts, 750 and 500 ft. in depth, both in barren ground. May prospect property at greater depth.

Coconino County

POWER OF MOONEY FALLS on Cataract Creek may be utilized for working nearby mines of Northern Arizona Lead and Zinc Co. which has even considered establishing electrolytic reduction plant. A dozen years ago a company spent several hundred thousand dollars trying to utilize the power of Mooney Falls, 250 ft. high, and Bridal Veil Falls, 144 ft., with about 10,000 miners inches of flow, but failed. The Northern Arizona company plans tramway from mines in Cataract Cañon to the cañon rim.

NAVAJO COPPER CO. (Flagstaff)—New camp of this company, 105 mi. northeast of Flagstaff, is to be named Bobsburg, after Robert Mitchell, the leading spirit of the enterprise. Carbonate ore from surface is being hauled to Flagstaff on motor trucks for shipment to El Paso smeltery. New buildings being erected for store and office uses, and for housing force of 200 men. May treat carbonate ore by leaching. Eugene de Sabla, 120 Broadway, New York, is interested.

Gila County

NEW DOMINION MINES (Globe)—Working 30 men and mining surface carbonate ores for shipment. Shaft retimbered to bottom, 250 ft.

WRIGHT & BUCKINGHAM (Copper Hill)—These lessees of group near the Iron Cap have shipped 13 carloads of manganese ore to Chicago and now have contract for steady supply to Illinois Steel Co. May install washing plant.

Pima County

GUNSIGHT DISTRICT again active, with a number of mines producing silver-lead ore. High-grade ore reported on Griffin-Johnston claims. Thirty years ago, district was considered one of the richest in Arizona, but it declined with the fall in the price of silver.

AJO CONSOLIDATED (Ajo)—Fourteen claims adjoining the New Cornelia and this company's properties have been added to the latter's holdings. The sellers were W. M. Gillard, of Ajo and Fred Z. Steele, of Tempe; consideration of $10,000 cash and some stock. Company has put down more than 50 drill holes.

NEW CORNELIA COPPER (Ajo)—The labor strike failing. Troops now at Ajo to assist in maintaining order and about 700 men are back at work. The most important feature of the week of Dec. 23 was the starting of the first steam shovel. Date of starting production will be delayed by the strike.

MILE WIDE COPPER (Tucson)—This company is installing a Sullivan W. J. 3 angle-type compressor and 100-hp. Fairbanks-Morse oil engine. Contemplate 6,000-ft. crosscut tunnel connecting Alta and Santa Cruz valleys and reducing railroad distance to Copper King shaft from 18 to 5 mi. Tunnel will pass through Orient group of claims. W. J. Bloch, of Bisbee, has been appointed assistant superintendent and will make geologic map of that portion of Tucson mountains embracing the company's property.

Yavapai County

UNITED VERDE EXTENSION (Jerome)—Erection of a smelting plant at an expense of $1,500,000 in the Jerome district is being definitely considered by the directors who may take final action at the coming meeting of the board. Much of the ore is now going to the Consolidated Arizona smeltery at Humboldt. Ore reserves between 1,300 and 1,400 levels have more than been maintained in the last half year and the grade is expected to be slightly better than previously estimated.

COLORADO

Boulder County

CARIBOU MINES AND MILLS CO. (Caribou)—The 100-ton mill closed for the winter on Dec. 20. Mill operations began last July. The mine had been idle for 30 years; it was once one of the most famous silver properties in Colorado. Main shaft now down 1,000 ft. and company will immediately sink another 100 ft. Mill operations will be resumed about Apr. 1. William C. Russell, general manager.

Clear Creek County

SEATON (Idaho Springs)—High-grade lead ore opened in Newhouse tunnel level; raise has been made 18 ft. above the level in ore; an eight-ton trial shipment returned $90 a ton. Present development is 2,000 ft. below outcrop. Cincinnati men interested. E. H. Machol, of Idaho Springs, is manager.

Summit County

JUNE BUG (Breckenridge)—High-grade shoot silver ore, 4 to 6 in. wide, opened in breast of tunnel by lessees.

NEW YORK (Breckenridge)—Lead ore opened in lower tunnel, 450 ft. from portal. Raising in ore now under way. Shoot is large. Mill may be built next spring; meantime, ore will be treated in Old Union mill.

MICHIGAN (Kokomo)—Fifty tons iron-sulphide ore assaying well in gold and silver shipped daily to Globe smeltery, Denver; lead ore shipped to Leadville. No. 19 Imperial type Ingersoll-Rand compressor and several Jackhamers installed. Main tunnel now in 750 ft.

WASHINGTON (Breckenridge) — Considerable work being done by lessees. Main lessee, P. M. Tyler, has developed considerable ore, and will do more extensive work next spring. Good-grade lead ore opened in incline by lessee Ben Bentson. Other lessees will work placer ground of company next spring; pipe line now being laid from Illinois Gulch.

PIONEER CONSOLIDATED (Breckenridge)—Mill now treating ore from Extension vein; brought out through Jumbo workings. Construction of new boarding house, one of largest in district, now under way. Old Jumbo drift to Deadwood workings, where bodies of good-grade are known to exist, being opened. Contractors driving main tunnel.

GOLDEN QUEEN MINING CO. (Kokomo)—Porphyry vein 15 to 25 ft. wide with shoots of high-grade silver ore opened. Shaft sunk 40 ft. and 40 ft. of drifting done. Tunnel, now in over 375 ft., being driven to cut vein at depth of 200 ft. Several cars ore, assaying $60 to $100 per ton in silver, reported shipped recently. Bonded indebtedness of company paid off. Crew of 18 men employed.

MICHIGAN

Copper

MOHAWK (Mohawk)—Contracted with General Electric Co. for a 1,250-kw. steam turbine for the mill at Traverse City.

NEW BALTIC (Houghton)—Specimens from drilling brought in to Houghton show amygdaloid of good character.

CHEROKEE (Houghton)—Although good ore was encountered in the eastern drift at the 118-ft. level, this work has been discontinued to concentrate on sinking. Shaft now down about 160 ft.

CALUMET & HECLA (Calumet)—Experimenting in oil flotation, also with new rock drill that is expected to be more efficient in rock containing bunches of copper.

NEW ARCADIAN (Houghton)—Larger skip installed; gage of tracks widened and laid to bottom of shaft, the 1,500-ft. level. New hoist now running; rockhouse engine and crusher expected to be in commission by Jan. 1.

COPPER RANGE (Painesdale)—Framework and roofing of new extension to Baltic mill is completed. Work on the concrete floors and machinery foundations is being pushed. Extension will be used for regrinding tailings. Mine shipping about 5,500 tons daily.

MICHIGAN (Rockland)—Development of Ogimah lode temporarily checked by fault which throws present face of the drift into trap; the course of the mineral is now being worked out. In the Evergreen lode about 30 ft. of mass copper has been encountered. Mass copper also found on the east side at fifth level.

Iron

AMASA-PORTER (Amasa)—New hoist purchased. Operations to be rushed.

DOBER (Iron River)—Water is being bailed and pumped from workings again. Mine was flooded to put out fire in the black slates. Unwatered few weeks ago, but fire rekindled.

FORTUNE LAKE (Crystal Falls)—Shaft now down over 100 ft. Will be sunk to 300 ft. before first level is started. Ore lies close to surface and will be well developed by time navigation opens again.

ISABELLA (Palmer)—Shipments from this mine in Sec. 29, 47-26, Marquette County, were nearly triple those of last year. In 1916, total shipments to Escanaba docks were 98,683 tons of which 72,117 tons were nonbessemer ore. Mine owned by Cascade Mining Co. of Hibbing, Minn., Oscar B. Warren, general manager.

MINNESOTA

Mesabi Range

SUSQUEHANNA (Hibbing)—Operations for season closed; 764,190 tons shipped this year by Rogers, Brown Iron Co.

BENNETT (Keewatin)—Shipments from this mine of the Keewatin Mining Co. in 1916 were: Bessemer ore, 171,251 tons; nonbessemer, 501,676; total for season, 672,927 tons—shipped to Great Northern ore docks. Oscar B. Warren, of Hibbing, general manager.

OLIVER IRON MINING (Eveleth)—Company has started one of largest stripping jobs in history of range at the Spruce, Adams and Cloquet properties. Several shovels now working. Removal of overburden will continue for several years. Spruce and Adams pits will be joined in few years.

PICKANDS, MATHER & CO. (Marble)—Sullivan & Hale Exploration Co. has disposed of its property between Marble and Calumet to Pickands, Mather & Co. Stripping is to be started immediately. Ore developed six years ago by diamond drills. Butler Bros. have stripping contract. About 400,000 cu.yd. to be moved before ore can be mined. Mine is near Hill Annex mine, now being stripped.

HIBBING PIT MINES have stopped shipping for the season. Shovels working at some mines where stripping is to be continued throughout the winter. All underground properties are active. There will be a great deal of ore in stock by spring. Some ore going to new plant of Minnesota Steel plant near Duluth, which has used 590,000 tons of Mesabi ore this season. It is believed that about 750,000 tons will be sent there in 1917.

MISSOURI

Joplin District

WORLEY & CO. (Commerce, Okla.)—Will reopen ground at Big Chief mine, where they have been operating mill on tailings for several months.

GOLDEN ROD (Tar River, Okla.)—Encountered lead ore in cutting pump station at 196 ft. Installing Pomona pump to make possible working of lower level.

ARROW (Aurora)—At a cost of about $25,000, this company is moving mill from Joplin camp to lease near Red Wasp mine at Aurora. Good orebody proved by drilling.

CORNFIELD (Tar River, Okla.)—Name of mine changed to Lucky Bill. Company which now has property is erecting second mill, to be known as Lucky Junction.

JAMES LUKE (Carthage)—With associates is prospecting on Ravenswood lease at Reeds, abandoned by U. S. Smelting Co. last summer. Good holes reported and new mill likely.

SYMMES (Joplin)—Rich strike in drill hole in new portion of Dixie lease at Prosperity. Thirteen feet of cuttings contained 66.45% blende, one of the best holes ever recorded in district. Sinking of new shaft southeast of mill probable.

McCONNELL (Tar River, Okla.)—These zinc mines near Picher, Okla., have been taken over by H. J. Cantwell, of St. Louis, representing Boston interests. First openings in Picher-Century-Cardin district and have been good producers. New owners sinking new shaft and later will erect second mill.

MONTANA

Jefferson County

BOSTON & MONTANA DEVELOPMENT (Elkhorn)—While running crosscut to the Idanaha vein, encountered 4 ft. of milling ore containing copper sulphides.

Silver Bow County

BUTTE & LONDON (Butte)—In north crosscut encountered a 25-ft. vein, 18 ft. of which is said to assay 1.2% copper, 8% zinc and some silver.

PILOT-BUTTE MINING CO. (Butte)—On Dec. 15, petition was filed in district court by company asking dissolution of corporation, all property having been sold to Anaconda company.

ANACONDA (Butte)—October record of accidents in company's mines was not so good as in September. All told, there were 30 accidents in a total of 344,523 shifts, or an average of 0.87 to every 10,000 shifts. In 10 out of the 27 mines there was not an accident.

GREAT BUTTE COPPER CO. (Butte)—Has just installed a station pump on 500-ft. level of Calumet shaft and retimbering to the 1,000-ft. level will now be rushed. The cave-in, encountered above the 500 has all been cleared up and below timbers seem to be in good shape. Shaft was caved from the 385-ft. point to the 500.

DAVIS-DALY (Butte)—The Ophir 150-ton mill has started treating zinc ore of this company. As soon as capacity of mill is increased, zinc output will be augmented to 200 and later to 500 tons per day. Copper ore now being blocked on 1,200, 1,400, 1,500, 2,400 and 2,500 levels of company's Colorado mine; within two weeks it is expected new hoisting engine will be in commission, when it will be possible to increase tonnage of copper ore now being shipped to Washoe smeltery.

BUTTE-DULUTH (Butte)—Shipment of precipitates to the Washoe smeltery has been made by the Mines Operating Co., which has this property under lease. Shipment consisted of 60 tons and the precipitates are said to run about 90% copper. Company was compelled to shut down the plant last week for the lack of acid; shipments on way from Denver but severe weather interfered with the delivery. Machinery needed to increase capacity from 200 to 500 tons per day has been ordered.

NEVADA

CONSOLIDATED COPPERMINES CO. (Kimberly)—New directors of this company include Albert E. Humphreys, of Charleston, W. Va., and Denver; Albert E. Humphreys, Jr., of Denver; Thomas A. Merritt, of Duluth; and I. W. Bernheim, of Louisville. Thomas F. Cole has retired from the directorate.

OHIO

VALLEY SMELTING CO. (1320 Citizens Bldg., Cleveland)—Cleveland and Detroit men will build plant in Cuyahoga Valley for smelting and refining nonferrous metal wastes. Officers of new company are Joseph Sillman, president; Charles O. Patch, vice-president and treasurer; H. D. Le Bel, general manager, and H. B. McGraw, secretary.

OREGON

QUICKSILVER properties in Jackson County have been active this year, and production is expected locally to reach 300 flasks. Operating properties are the Black Butte Quicksilver, Bonanza, Mountain King and the Utah Quicksilver Co.

COPPER MINES in southern Oregon are developing favorably. Active mines in Josephine and Jackson Counties include the Alameda, Queen of Bronze, Copper Queen and the Waldo. The Iron Dyke, in Baker County in eastern Oregon, shipped 50 to 75 tons daily early in the year and lately completed its 150-ton flotation plant.

UTAH

Juab County

RIDGE & VALLEY (Eureka)—Car of ore from 1,700 level brought $2,000, net smelter returns.

SIOUX CONSOLIDATED (Eureka)—Shaft down to 800 level. Station to be cut. Further sinking as well as drifting to be done.

MAY DAY (Eureka)—Dividend of 2c. a share paid Dec. 23, making $56,000 for year. Shipments for 11 months about 3,500 tons; shipped in November in six cars.

CHIEF CONSOLIDATED (Eureka)—Plans to enlarge shaft, and make it double compartment all the way down, as it is below the 1,200. Expects to do this work without hampering production.

UNITED TINTIC (Eureka)—Gasoline hoist installed in north end of property. Shaft—now down 100 ft.—to be sunk further. Property not far from Tintic Standard. Ore opened in southern end in Minnie Moore lease.

MAMMOTH (Mammoth)—Double the usual quarterly dividend—$40,000 or 10c. a share—paid Dec. 20, bringing total for 1916 to $100,000. Dividends to date, $2,420,000. During 11 months of 1916, shipped 685 cars or about 30,000 tons.

Salt Lake County

ALTA SHIPMENTS have been irregular recently owing to the snowslides in Little Cottonwood Cañon, beginning unusually early. The week ended Dec. 18, however, five or six cars were brought to market, most of the ore coming from the South Hecla and the Michigan-Utah. The Sells shipped a car recently, and concentrates from the Albion are being prepared for the market.

SILVER SHIELD (Bingham)—Another car shipped from Back vein. Ore opened in new raise to Miracle stope.

OHIO COPPER (Bingham)—Expected that company will take over mine and mill Jan. 1, no extension being granted General Exploration Co. now working property under lease. Rumored that Alfred Frank—formerly manager of the Ohio Copper and at present directing leasing operations—will be manager for company. Mill treating 2,000 tons daily; flotation equipment may be added, and capacity brought up to 3,000 tons.

UTAH METAL AND TUNNEL (Bingham)—Fifth orebody in Utah Metal end of property officially reported. Followed about 25 ft., and four sets wide. Capacity of mill being brought up from 225 tons daily to 300 tons. Low-grade ore at present treated in coarse state, to be reground and treated by flotation. Earnings from mill expected to be increased $25,000 monthly. Company report for nine months' operation—ended Oct. 1, 1916—of Utah Metal and Bingham-New Haven ground shows 69,364 tons of ore and concentrates wet weight to have been shipped, which sold for $1,262,752. Gross income, with $37,161 additional income added was $1,299,913, and total expense $732,176, leaving operating profit of $567,737. Development work amounting to 10,190 ft. was done, during which 4,481 tons of ore were taken out.

Summit County

ONTARIO (Park City)—Shaft being retimbered following recent cave.

BROADWATER MILLS (Park City)—Remodeling plant to treat tailings. To be ready about Feb. 1. Forty-eight men working.

JUDGE MINING AND SMELTING (Park City)—Weekly shipments of about 450 tons of crude ore and concentrates being made. November production was 1,733 tons, October 1,878 tons, and in September 2,700 tons. Dividend of 25c. a share paid Dec. 20, making $435,000 or $1 a share for 1916.

CANADA

Alberta

COYNE PETROLEUM CO. (Edmonton)—Will drill four wells in the Wabiscaw River area, south of Fort Vermilion, where geological survey was made last summer.

Ontario

ORE SHIPMENTS from Cobalt district in November, as reported by Arthur A. Cole, mining engineer for Temiskaming & Northern Ontario Ry., were: Cobalt proper: Buffalo 31.69 tons; Coniagas, 104.70; Cobalt Comet, 49.13; Crown Reserve, 72.70; Hudson Bay, 70.98; Kerr Lake, 74.67; La Rose, 87.32; Mining Corporation of Canada, 94.20; McKinley-Darragh, 166.64; Nipissing, 535.70; O'Brien, 33; Penn Canadian, 54.10; Temiskaming, 81.54; Trethewey, 41.67; from Elk Lake by the Miller Lake-O'Brien, 25.95; total silver ore shipments 1,523.99 tons. From Porquois Junction by the Alexo, 332.65 tons of nickel ore.

INSPIRATION (Porcupine)—Second drill has started.

GOLD REEFS (Porcupine)—High-grade ore opened on 50-ft. level.

ADANAC (Coalbt)—Shaft down to 400 ft. level, where station is being cut.

McINTYRE (Schumacher)—Production in November, $142,000. This is the highest grade big mine in camp.

PLENAURUM (Porcupine)—Control being acquired by a Toronto syndicate to amalgamate with the McIntyre.

MAIDENS MACDONALD (Porcupine)—Resumed underground work—stopped while plant was being installed.

AURUM (Munro Township)—Another vein struck north of the Crœsus boundary. Has been stripped for 100 ft.; about 4 ft. wide showing visible gold.

VIPOND (Porcupine)—Proposed amalgamation with the North Thompson will be submitted to shareholders soon. Merger should result in decreased operating costs.

DOME (South Porcupine)—November production low, account closing down ball mill for shortage of liners. Important strike in horizontal drill hole at 700-ft. level, cutting 51 ft. averaging $14; same hole previously cut 10 ft. of $10 ore.

TRETHEWEY (Cobalt)—Financial statement shows cash in hand $78,594; value of silver unsold, $40,792; value of ore on hand, $21,000; total, $140,387.

HOLLINGER (Timmons)—New mill building under cover but complete installation of machinery will probably not be completed till next fall. Company offering 120,000 shares to shareholders at $6.50 to pay off debts and provide capital.

PORT ARTHUR COPPER CO. (Toronto)—This new company will operate in the Mine Center district and arrangements are being made with New York and Toronto men for erection of custom smelting plant at Port Arthur. J. F. Hewiston, of Port Arthur, interested.

DUTCH GUIANA

GOLD PRODUCTION for 10 months from various districts is estimated as follows: From Surinam River, by long toms and sluices, 234 kg.; from Saramacca River, 176 kg.; from Marowyne River, 17 kg.; from Lawa River, 210 kg. These results about 15% less than the yield in corresponding period of 1915.

The Market Report

Metal Markets

NEW YORK—Dec. 27, 1916

All of the metals were still unsettled and business in them was relatively light. Copper and spelter continued to be distinctly reactionary.

Copper, Tin, Lead and Zinc

Copper—The market was made especially by offers of copper for resale, considerable lots of such copper turning up in a variety of quarters. On the other hand, there was some resistance to pressure through uncovered consumers who stood ready to take copper. Some business was done for March-April delivery, buyers who were willing to contract so far ahead showing a continued confidence in the situation, but the bulk of the business reported was for near-by and first-quarter delivery. In the latter part of the week, January was quoted at 30¼@30½, February, at 29¾@30c., and March, 29¼@29½c., all regular terms. First-quarter delivery was offered at 30c., r.t.

Copper Sheets—Base price for copper sheets remains unchanged at 42c. for hot rolled and 43c. for cold rolled. Wire is quoted 37c. f.o.b. mill.

Tin—Very little business was done in this metal. At the beginning of the week spot was 40¼c. and futures, 40⅜c. At the close, spot was 40¼c. and futures, 40c.

Lead—The situation in this market is that producers have disposed of about all of their January supply and much of what they expect to produce in February. The near-by market is therefore in the control of second hands, who were able to realize the price that the principal producer continues to quote, there being a fair domestic demand. There has been talk of lead offered at lower prices, but buyers who would be willing to take it do not seem to be able to find it. There is, however, some bearish sentiment in lead and sellers could probably be found to contract to deliver lead in February and later at concessions from present prices. There was not much inquiry from abroad reported in the market this week, but China and Japan were still inquiring and were talking about taking February shipment, not being able to get January. The lead producers of Southeastern Missouri have become greatly troubled by transportation difficulties, which are preventing some of them from shipping lead and are making it hard for all of them to get in enough coal to keep the mines unwatered.

Spelter—The price continued to crumble away from day to day. On Dec. 23 producers offered at sharp concessions and succeeded in placing a fair tonnage for first-quarter delivery, some being taken by galvanizers. Brass special for prompt delivery was sold at 10c. Right through the week, second-quarter spelter was offered at low prices, producers being manifestly desirous of getting more orders on their books than at present. The spelter market is quite unsettled. Producers who are bearish avoid anything that might be regarded as aggressive selling, while on the other hand, many producers are standing aloof, expecting a contraction of production through gas troubles and a rally in the market.

Zinc Sheets—Base price of zinc sheets remains at $21 per 100 lb. f.o.b. Peru, Ill., less 8% discount.

Other Metals

Aluminum—The market is extremely quiet. Prices remain nominally at 63@65c. per lb. for No. 1 ingots, New York.

Nickel—There is no change in the market quotations for nickel. Price remains at 45@50c. per lb.; electrolytic commands an extra 5c. per lb.

Quicksilver—The market was quiet and steady at $80. San Francisco reports by telegraph $78, firm.

Antimony—Market steady, fair business, quotations unchanged at 14½@15c. January-February shipments from China are quoted at 13@13½c. c.i.f., New York, duty unpaid.

Gold, Silver and Platinum

NEW YORK—Dec. 27

Gold—According to advices from London under date of Dec. 7, the Bank of England reserve of gold against its note issues showed a decrease of £51,075 as compared to the previous week.

Silver—Owing to the holiday season there has been some recession in the price of silver. The market is quiet and dull but the undertone is good and after the middle of January unless some unexpected condition arises there is a fair chance of some improvement in the price.

In the "Journal" of Dec. 16, the price of silver at London on Dec. 8 was incorrectly quoted. It should have been 35⅛ pence.

According to report of Samuel Montagu & Co., London, under date of Dec. 7, the steadiness at which the price of silver has been maintained round about 36d. is significant. The fluctuations have kept within ¼d. and the movements have tended upward. This has been the case notwithstanding that the China exchanges have receded from the high point recently touched and seems to suggest that a return of the China exchanges to a lower level may remove little more than the driving power which the upward movement has had upon the price of silver. So much silver has been withdrawn for export from the stock at Shanghai that unless, and until it is replenished from the interior—an operation which would of ccurse take some time—fresh sales of silver on account of China are very doubtful. Meanwhile the Indian Bazaars are taking favorable views of the market, impelled no doubt by the fall during one week of 219 lacs in the holding of silver—coined and uncoined—by the Indian treasury. This reduction during one week is the largest since January, 1912, when a drop occurred of 240 lacs.

Zinc and Lead Ore Markets

Joplin, Mo., Dec. 23—Price quotations per 2,000 lb.: Blende, high, $92.40; 60% zinc, premium ore, $90, medium, $85@75, low, $65; calamine per ton 40% zinc, $55@45; average selling price all grades of zinc, $83.31 per ton. Lead, high price, $101.30; base, $100@96; average selling price, all grades of lead, $93.22 per ton.

Shipments of the week: Blende, 6,277 tons; calamine, 761 tons; lead, 1,284 tons. Value, all ore the week, $706,050; 51 weeks, $37,292,770.

The market was without support until near the end of the week, several large orders were received by buyers for next week's delivery. Freezing to zero weather has nearly eliminated calamine production, and greatly retarded blende production in isolated localities. The district is enveloped in a snow that fell Thursday, part of which was thawed today.

Platteville, Wis.—The report for last week, delayed in transit, says that quotations for the district were according to the following figures: Base price per 2,000 lb. ton for material assaying 60% zinc, $93 for premium ore down to $89 for medium grades. Base price per 2,000 lb. ton for material assaying 80% lead, $95. Shipments for the week ended Dec. 16, 1916, were 2,876 tons of zinc ore, 124 tons of lead ore, and 958 tons of sulphur ore. For the year to date the figures are 128,2893 tons of zinc ore, 4,495 tons of lead ore, and 31,681 tons of sulphur ore. Shipped during the week to separating plans, 4,495 tons of zinc ore.

Other Ores

Tungsten Ore—The activity has continued in spite of the peace talk, and considerable business was done at $17.50. Several hundred tons were reported under option to foreign buyers at the same price. We quote the market at $17@17.50.

Molybdenum Ore—Continues very firm, with very little ore offered. The tendency is regarded as advancing. Business in ferromolybdenum was done at $3.80 per lb.

Manganese Ore—The market for foreign manganese ore, 50%, is not very clearly defined according to "Iron Trade Review," for the reason that offerings are scant and there have been no known sales recently. A fair statement of the market would be 65 to 70c. per unit of manganese at tidewater. Buyers have offered 60c. per unit, which sellers have declined to accept. Some sellers will not quote less than 70c. per unit. In speaking of 50% foreign ore, reference is made especially to Brazilian and Indian ore.

Imports during the week at Baltimore included 8,300 tons of manganese ore from Brazil and 367 tons from Liverpool.

Other Minerals

(Quoted by Foote Mineral Co. for carload lots, Philadelphia.)

Barytes, 99%, ground, per ton, $18.

Beryl, minimum 12% BeO, per lb., 4c.

Chrome ore, lumps, min. 40%, Cr_2O_3, per unit, $1.

Fluorspar, metallurgical, per ton, $28.

Magnesite, raw, per ton, $25.

Magnesite, calcined, per ton, $65.

Manganese ore, min. 80% MnO_2, max. 1.6% Fe and 0.05% Cu, per ton, $60.

Manganese ore, standard Brazilian, per unit, 65@75c.

Tantalite, guaranteed 65% Ta_2O_5, per unit, $15.

Monazite sand, min. 5% ThO_2, per lb. of thorium oxide, $1.90.

Rutile, 24-mesh concentrates, min. 95% TiO_2, per ton, $95.

Ilmenite, min. 50% TiO_2, per ton, $22.50.

Carnotite, 2% U_3O_8, per ton, $100.

Zirkite, metallurgical grade, 80% ZrO_2, per ton, $120.

SILVER AND STERLING EXCHANGE

Dec.	Sterling Exchange	Silver New York, Cents	Silver London, Pence	Dec.	Sterling Exchange	Silver New York, Cents	Silver London, Pence
21	4.7544	76⅛	36 13/16	25			
22	4.7544	75⅞	36 11/16	26	4.7544	75⅞	
23	4.7544	75⅞	....	27	4.7544	75⅞	36⅛

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

DAILY PRICES OF METALS IN NEW YORK

Dec.	Copper Electrolytic	Tin Spot.	Lead N. Y.	Lead St. L.	Zinc St. L.
	30⅛		7⅛	7.10	9⅛
21	@31⅛	41⅛	@7⅛	@7.40	@9⅛
	30⅛		7⅛	7.20	9⅛
22	@31⅛	40⅛	@7⅛	@7.40	@9⅛
	29⅛			7.30	8⅞
23	@30⅛	40⅛	7⅛	@7.40	@9⅛
25	....	....	....	....	....
	29⅛			7.30	8⅞
26	@30⅛	40⅛	7⅛	@7.40	@9⅛
	29⅛			7.30	8⅞
27	@30⅛	40⅛	7⅛	@7.40	@9⅛

The above quotations are our appraisal of the average of the major market based on sales as made and reported by producers and agencies: and represent to the best of our judgment the prevailing values of the metals for the deliveries constituting the major markets, reduced to basis of New York, cash, except where St. Louis is the normal basing point.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold on "regular terms" (r.t.), including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.25c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for spelter are for ordinary Prime Western brands. We quote New York price at 17c. per 100 lb. above St. Louis.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1 cents.

LONDON

Dec.	Copper Standard Spot	Copper Standard 3 Mos.	Copper Electrolytic	Tin Spot	Tin 3 Mos.	Lead Spot	Zinc Spot
21	142½	136½	155	179½	181½	30½	54½
22	141½	135½	154	177	179	30½	52½
23	....	....	....	....	....	....	....
25	....	....	....	....	....	....	....
26	....	....	....	....	....	....	....
27	140½	....	....	176	178	30½	51½

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb. For convenience in comparison of London prices, in pounds sterling per 2,240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21½ cents.

Iron Trade Review

NEW YORK—Dec. 27, 1916

The first effect of peace talk upon the steel trade was a halt in new orders, but that has passed and the market has picked up considerably. Here and there is a change of attitude as to placing orders for the far future, and calculations are based on indefinite continuance of the war. What has happened mainly is that peace is taking a definite place in calculations, whereas it had no place before or was thought of too far in the future to affect the present plans.

Domestic pig-iron inquiries have fallen off sharply and the export business is less. Italy has just taken 10,000 tons more of bessemer iron. Steel making pig iron in the Pittsburgh district is quiet.

Blast furnaces are facing much higher coke costs. They refused to contract at $4 for the first half, but $4.50 is now the producers' figure. But coke has sold in considerable quantities at $9.

The general use of 50% ferrosilicon in the steel works operations make important the reported limitation of Canadian electric power now employed at Niagara in the making of this product for the American market. The movement is causing concern to other American users of Canadian power.

PITTSBURGH—Dec. 26

Everything else marketwise is now subsidiary to the transportation situation. Prospects of better or poorer demand, price advances, whether the war is to end in six months or two years, is of less interest than how much material can be made and shipped. Car supplies are no better, which means that they are very poor. Possibilities of shipping materials are reduced because there are more embargoes. Some mills do not have cars enough in which to ship their product and have to pile it or reduce production, while some cars are loaded and cannot be shipped because there are embargoes as to the intended destinations.

To these conditions there is now added a fuel famine, particularly as regards coke. Coke labor is scarce, on account of the holidays, and cars are still scarcer. The Carnegie Steel Co. last week banked 14 of its operating furnaces, and had six out of blast, chiefly on account of coke scarcity, so that 20 of its 57 furnaces are not operating. It was hoped the banked furnaces would resume today but coke conditions are such that it is more likely additional furnaces will have to be banked. Other furnace interests are in as bad shape, some perhaps worse. The Carnegie Steel Co. has a large reserve of pig iron and scrap, chiefly the latter, but most steel interests have practically none, and thus a continuance of present conditions as to coke will reduce the output of finished steel.

The general prospect is that considerable steel production will be lost in the next two or three weeks, while the balance of probability is that production will be curtailed more or less for many weeks, until spring weather arrives.

On the afternoon of Dec. 20 the Carnegie Steel Co. announced advances of $2 a ton in bars, shapes and plates, making bars 3.00c., shapes 3.10c. and plates 3.60c. Some independents had already been quoting these prices and the advanced prices were then generally adopted. As the market had been very quiet for a week, and as all, or nearly all, the previous advances in this movement had occurred during very active buying, this last advance is generally interpreted in the trade as being one of the old-time advances, calculated to stiffen the market by making the recognized market prices higher than the price on any of the business already entered. Naturally it is surmised that the steel interests recognize that the buying movement is over and that the next thing to do is to proceed with the filling of the business on books, plus such business as always drifts in, even in a very quiet market. Barring serious accidents, the mills may be regarded as assured of full operations for a twelvemonth, subject to such curtailment as may occur through transportation facilities being insufficient.

Some reports have been published to the effect that the slowing down of activity following the German peace overture was temporary and has already yielded to greater activity, but no such condition is observed here, the market being rather still duller, as a combination of holiday dullness, the sobering effect of the peace proposal, and the fact that the feverish activity of November could not be maintained, some of the November business being seasonal, and not such as could be repeated month after month.

Pig Iron—The pig iron market is quieter, and is quite inactive as to late deliveries, while as to early deliveries the business is confined to small lots, delivery premiums being paid for foundry and malleable. The scarcity of coke is making prompt iron daily more scarce, by curtailing pig iron output. We quote: Bessemer, $35@36; basic, $30; foundry, $30@32; malleable, $30@33; forge, $29@30, f.o.b. valley furnaces, 95c. higher delivered Pittsburgh.

Steel—There have been a few transactions, in billets for export and in sheet bars for early deliveries, showing that the market for soft steel is quotable about $3 higher, and we now quote billets at $60@62 and sheet bars at $60@63, Pittsburgh. Rods are $5 higher at $75@80 while forging billets are stronger, at $80@85.

STOCK QUOTATIONS

N. Y. EXCH.†	Dec. 26
Alaska Gold M.	11⅛
Alaska Juneau	7¾
Am.Sm.&Ref.,com.	105
Am. Sm. & Ref., pf.	115
Am. Sm. Sec., pf. A	98
Am. Sm. Sec., pf. B	94
Am. Zinc	38⅛
Am. Zinc, pf.	72
Anaconda	83⅜
Batopilas Min.	1⅜
Bethlehem Steel	500
Bethlehem Steel, pf.	132
Butte & Superior	47½
Chile Cop.	25⅝
Chino	54½
Colo.Fuel & Iron	46
Crucible Steel	62
Dome Mines	20
Federal M. & S.	12
Federal M. & S., pf.	39½
Great Nor., ore ctf.	36½
Greene Cananea	44⅛
Homestake	128
Inspiration Con.	58
International Nickel	43
Kennecott	45⅛
Lackawanna Steel	84⅛
Miami Copper	38⅛
Nat'l Lead, com.	60⅛
National Lead, pf.	111⅛
Nev. Consol.	24⅛
Ontario Min.	6
Quicksilver	2⅛
Quicksilver, pf.	2
Ray Con.	26⅛
Republic I.&S.,com.	78
Republic I. & S. pf.	105
Sloss-Sheffield	61⅛
Tennessee C. & M.	16⅛
U. S. Steel, com.	107⅛
U. S. Steel, pf.	119⅞
Utah Copper	103
Va. Iron C. & C.	48

N. Y. CURB†	Dec. 26
Buffalo Mines	1.15
Butte & N. Y.	1⅛
Butte C. & Z.	11⅛
Caledonia	.49
Can. Cop. Corpn.	1⅛
Cashboy	.07
Cerro de Pasco	37⅛
Con. Ariz. Sm.	1⅛
Con. Coppermines	3⅛
Con. Nev.-Utah	.12½
Crystal Cop.	.62
First Nat. Cop.	3⅛
Florence	.70
Goldfield Con.	.63
Goldfield Merger	.06
Granite	.40
Hecla Min.	7⅛
Howe Sound	7⅛
Hercone Verde	1/16
Joplin Ore & Spel.	.35
Kerr Lake	4⅛
Magma	40⅛
Majestic	.75
McKinley-Dar-Sa.	.51
Mother Lode	.44
Nevada Hills	.22
N. Y. & Hond.	15
Nipissing Mines	9⅛
Oro	‡.03⅛
Ray Hercules	4⅛
Rochester Mines	.66
St. Joseph Lead	17⅛
Standard S. L.	1
Stewart	.21
Success	.41
Tonopah	6
Tonopah Ex.	4⅛
Tribullion	.25
Troy Arizona	.57
United Zinc	4
White Knob, pf.	1⅛
White Oaks	5
Yukon Gold	2⅛

SAN FRAN.*	Dec. 26
Alta	.04
Andes	.15
Best & Belcher	.05
Bullion	.01
Caledonia	.25
Challenge Con.	.05
Confidence	.10
Cons. Imperial	‡.01
Con. Virginia	.09
Gould & Curry	.03
Hale & Norcross	.08
Jacket-Cr. Pt.	.03
Mexican	.15
Occidental	.65
Ophir	.14
Overman	.04
Savage	.05
Seg Belcher	.02
Sierra Nevada	.13
Union Con.	.49
Utah Con.	.02
Belmont	4.70
Jim Butler	.83
MacNamara	.06
Midway	.20
Mont.-Tonopah	.18
North Star	.13
Rescue Eula	.26
West End Con.	.68
Atlanta	.09
Booth	.09
C.O.D. Con.	‡.02
Comb. Frac.	.05
D'field B.B.	.04
D'field Daisy	.04
Jumbo Extension	.28
Round Mountain	.39
Sandstorm Kendall	‡.04
Silver Pick	.24
Argo	.06
Ariz. Central	.08
Big Jim	1.12½
Lazy Boy	.07
Nellie	.30
Tom Reed	1.95
United Eastern	5.00
United Western	‡.04

BOSTON EXCH.*	Dec. 26
Adventure	3¼
Ahmeek	100
Algomah	1/16
Allouez	65
Ariz. Com., ctfs.	14⅛
Bonanza	‡.40
Butte-Balaklava	2
Calumet & Ariz.	79½
Calumet & Hecla	550
Centennial	22
Copper Range	65⅛
Daly West	2½
East Butte	17
Franklin	8⅛
Granby	91⅛
Hancock	17
Hedley	‡24
Helvetia	.70
Indiana	3½
Island Cr'k, com.	59½
Isle Royale	35
Kewecnaw	4⅛
Lake	12
La Salle	‡4½
Mason Valley	5⅛
Mass	14⅛
Mayflower	2⅛
Michigan	3⅛
Mohawk	96
New Arcadian	5⅛
New Idria	15⅛
North Butte	23⅛
North Lake	2⅛
Ojibway	1⅛
Old Colony	2
Old Dominion	65
Osceola	93
Quincy	89½
St. Mary's M. L.	89
Santa Fe	2
Shannon	9
Shattuck-Ariz.	27
So. Lake	4⅛
So. Utah	.30
Superior	13
Superior & Bost.	5⅛
Tamarack	47⅛
Trinity	6⅛
Tuolumne	2/16
U. S. Smelting	63½
U. S. Smelt'g, pf.	51⅛
Utah Apex	3⅛
Utah Con.	18
Utah Metal	6⅛
Victoria	6⅛
Winona	4⅛
Wolverine	49
Wyandot	2⅛

BOSTON CURB*	Dec. 26
Alaska Mines Corp.	1.03⅛
Bingham Mines	4⅛
Boston Ely	.50
Boston & Mont.	.67
Butte & Lon'n Dev.	.45
Calaveras	4
Calumet-Corbin	.01⅛
Chief Con.	2
Cortez	.30
Crown Reserve	.35
Davis-Daly	6
Eagle & Blue Bell	1⅛
Houghton Copper	1⅛
Iron Cap Cop., pf.	17⅛
Mexican Metals	.40
Mines of America	1⅛
Mojave Tungsten	1⅛
Nat. Zinc & Lead	.55
Nevada-Douglas	1⅛
New Baltic	2⅛
New Cornelia	15
Ohio Copper	1⅛
Oneco	.80
Rex Cons.	.50
Rilla	.05
United Verde Ext.	37

SALT LAKE*	Dec. 26
Big Four	.90
Black Jack	.05
Cardiff	7.25
Colorado Mining	.16⅛
Crown Point	.05
Daly-Judge	8.00
Emma Cop.	4⅛
Empire Copper	1.50
Gold Chain	.17
Grand Central	.59
Iron Blossom	1.37½
Lower Mammoth	.06⅛
May Day	.10⅛
Opohongo	‡.01⅛
Prince Con.	1.32½
Seven Troughs	‡.03
Silver-King Coal'n	3.30
Silver King Con.	4.25
Sioux Con.	.12½
So. Hecla	1.30
Uncle Sam	.06
Wilbert	.09
Yankee	.20

TORONTO*	Dec. 26
Bailey	.06½
Beaver Con.	.40
Chambers Ferland	.15
Coniagas	4.75
La Rose	.53
Peterson Lake	.15
Right of Way	.08
T. & Hudson Bay	72.00
Temiskaming	.60
Wettlaufer-Lor.	.10½
Dome Exten.	.23
Dome Lake	.65
Foley O'Brien	.70
Hollinger	6.85
Jupiter	.35
McIntyre	1.83
Newray	1.38
Porcu. Crown	.65
Schumacher	.68
Vipond	.44
West Dome	.31½

STOCK QUOTATIONS—Continued

COLO. SPRINGS	Dec. 26
Cresson Con.	7.44
Doctor Jack Pot.	.08¾
Elkton Con.	.13
El Paso	.40
Findlay	.06
Gold Sovereign	.06⅛
Golden Cycle	2.62
Granite	.50
Isabella	.20
Mary McKinney	.27
Portland	2.00
Vindicator	1.49

LONDON	Dec. 9
Alaska Mexican	£0 12s 6d
Alaska Tre'dwell	2 15 0
Burma Corp.	3 12 6
Cam & Motor	0 10 6
Camp Bird	0 6 6
El Oro	0 7 0
Esperanza	0 9 9
Mexico Mines	3 10 0
Nechi, pfd.	0 12 0
Oroville	0 15 9
Santa Ger't'dis	0 9 0
Tomboy	1 1 0

* Bid prices. † Closing prices. ‡ Last Quotations.

MONTHLY AVERAGE PRICES OF METALS

Silver	New York			London		
	1914	1915	1916	1914	1915	1916
January	56.572	48.855	56.775	26.553	22.731	26.960
February	57.506	48.477	56.755	26.573	22.753	26.975
March	58.067	50.241	57.935	26.788	23.708	27.597
April	58.519	50.250	64.415	26.958	23.709	30.662
May	58.175	49.915	74.269	26.704	23.570	35.477
June	56.471	49.034	65.024	25.948	23.267	31.060
July	54.678	47.519	62.940	25.219	22.597	30.000
August	54.344	47.163	66.083	25.979	22.780	31.498
September	53.290	48.680	68.515	24.260	23.591	32.584
October	50.654	49.385	67.855	23.199	23.925	32.361
November	49.082	51.714	71.604	22.703	25.094	34.192
Dec.	49.375	54.971		22.900	26.373	
Year	54.811	49.684		25.314	23.675	

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

Copper	New York		London			
	Electrolytic		Standard		Electrolytic	
	1915	1916	1915	1916	1915	1916
Jan.	13.641	24.008	60.756	88.083	65.719	116.167
Feb.	14.394	26.440	63.494	102.667	*	133.167
March	14.787	26.310	66.152	107.714	*	134.000
April	16.811	27.895	75.096	124.319	*	137.389
May	18.506	28.625	77.600	135.457	*	152.522
June	19.477	26.601	82.574	112.432	95.333	137.455
July	18.796	23.865	76.011	95.119	91.409	125.500
Aug.	16.941	26.120	68.673	110.283	82.333	126.304
Sept.	17.502	26.855	68.915	113.905	85.250	134.071
Oct.	17.686	27.193	72.601	122.750	88.000	142.523
Nov.	18.627	30.625	77.744	134.659	93.273	155.432
Dec.	20.133		80.773		100.430	
Year	17.275		72.532			

Tin	New York		London	
	1915	1916	1915	1916
January	34.260	41.825	156.550	175.548
February	37.415	42.717	176.925	181.107
March	48.426	50.741	180.141	193.609
April	47.884	51.230	166.225	199.736
May	38.790	49.125	162.675	196.511
June	40.288	42.231	167.636	179.466
July	37.423	38.510	167.080	168.357
August	34.389	38.565	151.440	169.870
September	33.125	38.830	152.625	171.345
October	33.080	41.241	151.554	179.307
November	39.224	44.109	167.670	186.932
December	38.779		167.000	
Av. year	38.590		163.960	

Lead	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
January	3.729	5.921	3.548	5.826	18.606	31.167
February	3.827	6.246	3.718	6.164	19.122	31.988
March	4.053	7.136	3.997	7.175	21.883	34.400
April	4.221	7.630	4.142	7.655	21.094	34.368
May	4.274	7.463	4.182	7.332	20.347	32.967
June	5.932	6.936	5.836	6.749	25.170	31.011
July	5.659	6.352	5.531	6.185	24.611	28.137
August	4.656	6.244	4.520	6.088	21.946	29.734
September	4.610	6.810	4.490	6.699	23.151	30.786
October	4.600	7.000	4.499	6.898	23.994	30.716
November	5.155	7.042	5.078	6.945	26.278	30.500
December	5.355		5.266		28.807	
Year	4.673		4.567		22.917	

Spelter	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
Jan.	6.386	16.915	6.211	16.745	30.844	89.810
Feb.	8.436	18.420	8.255	18.260	39.819	97.762
Mar.	8.541	16.846	8.360	16.676	44.141	95.048
April	10.012	16.695	9.837	16.525	49.888	99.056
May	14.781	14.276	14.610	14.106	68.100	94.217
June	21.208	11.752	21.038	11.582	100.614	68.591
July	19.026	8.925	18.856	8.755	97.250	50.750
Aug.	12.781	8.730	12.611	8.560	67.786	51.587
Sept.	13.440	8.990	13.270	8.820	67.841	52.095
Oct.	12.800	9.829	12.596	9.659	66.536	54.159
Nov.	15.962	11.592	15.792	11.422	88.409	56.023
Dec.	15.391		15.221		89.400	
Year	13.230		13.054		67.553	

New York and St. Louis quotations, cents per pound, London, pounds sterling per long ton. * Not reported.

Pig Iron, Pitts.	Bessemer‡		Basic‡		No. 2 Foundry	
	1915	1916	1915	1916	1915	1916
January	$14.59	$21.60	$13.45	$18.78	$13.90	$19.70
February	14.55	21.16	13.45	18.93	13.90	19.51
March	14.55	21.81	13.45	19.20	13.95	19.45
April	14.55	21.65	13.45	18.95	13.95	19.45
May	14.61	21.78	13.60	19.11	13.83	19.58
June	14.70	21.95	13.67	18.95	13.77	19.34
July	14.94	21.95	13.91	18.95	13.68	19.20
August	16.01	21.95	15.31	18.95	14.75	19.25
September	16.86	22.88	15.95	19.58	15.70	19.53
October	16.95	24.61	15.96	21.26	15.80	21.51
November	17.57	29.12	16.47	27.23	17.20	25.60
December	19.97		18.44		18.95	
Year	$15.82		$14.76		$14.95	

‡ As reported by W. P. Snyder & Co.

Engineering and Mining Journal

WALTER RENTON INGALLS, *Editor*

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VOLUME 102 — DECEMBER 30, 1916 — NUMBER 27

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NUMBER OF COPIES PRINTED THIS ISSUE, 10,350

None sent free regularly, no returns from news companies, no back numbers.

The Subscribers' Forum

Conducted by the Business Manager of the Journal

They Stick

The following are quoted from two letters received recently from subscribers:

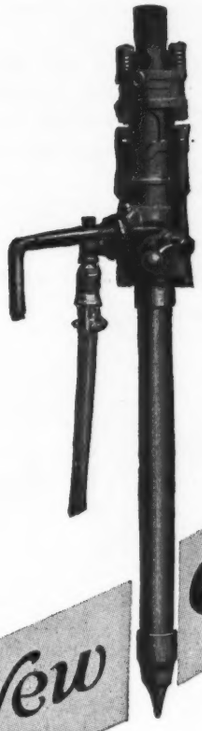
"For the past *seven* years I have been a subscriber and interested reader of the Engineering and Mining Journal. . . . "

And the other:

"I have been a reader of the Engineering and Mining Journal for the past *ten* years . . . . ."

The interesting thing here is the period of time and it is characteristic of Journal subscribers—

They stick.



A User Said:

New Cleveland Type "S" Stoper

"It Certainly Beats Anything I Have Ever Seen"

Then he adds: "Our Superintendent says it is the finest piece of machinery in the drill line he has ever used."

Here you have the testimony of both the drill operator and the superintendent.

We know if you will give "New Cleveland Pocket-in-Head Stopers" a fair trial you will be just as enthusiastic about them as these men.

Let us ship you a "New Cleveland" on the understanding that if, after a demonstration it does not prove entirely satisfactory, it can be returned without any obligation whatever.

Write us a letter or send in the coupon today for further information.

The Cleveland Rock Drill Co.

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New York—30 Church Street.
Ishpeming, Michigan—P. O. Box 234.
Denver, Colo.—1633 Tremont Street.
Salt Lake City, Utah—811 Walker Bank Building.
San Francisco—Harron, Rickard & McCone.
Los Angeles—Harron, Rickard & McCone.

Canadian trade supplied by
Cleveland Pneumatic Tool Co., of Canada, Limited,
Toronto, Ont.

Sign This Coupon—Tear It Off—Mail Now.

Mail Bulletin No. 35A and trial order blank to.....

Name.....

Address.....

Position.....

Name of Mine.....

City.....

State.....

12-30-16

LOOK

Over the equipment going into almost any mine in the Rocky Mountain Region

Look at the machinery in the mines in your district

Ask the man who is running the machines why there is so much with the "H. & B." nameplate

There are reasons—and good ones

Quality—Service—Price

All three are right. Write for Catalogs on any line of

Mechanical and Electrical Apparatus

"We Can Be of Service to You"

THE

HENDRIE & BOLTHOFF

MFG. & SUPPLY CO.

DENVER, COLORADO.

Some Big Users of Deister Simplex Tables

Inspiration Consolidated Copper Co., Miami, Arizona
Miami Copper Co., Miami, Arizona
United States Stores Co., Midvale, Utah
Pittsburgh Steel Ore Co., Riverton, Minn.
Alaska Juneau Gold Mining Co., Juneau, Alaska
Atolia Mining Co., Atolia, Calif.
Smuggler Union Mining Co., Telluride, Col.
Granby Mining & Smelting Co., Joplin, Mo.
Field Mining & Milling Co., Scales Mound, Ill.
Alaska Treadwell Gold Mining Co., Treadwell, Alaska
Bingham-New Haven Copper & Gold Mining Co., Bingham, Utah
Hollinger Gold Mines, Ltd., Timmins, Ont., Can.
Dominion Reduction Co., Cobalt, Ont., Can.
Prince Consolidated Min. & Smelting Co., Panaca, Nev.
McKinley-Darragh Savage Mines Co., Cobalt, Ont., Can.
Irtysh Corporation-Ridder Mining Co., Ridderiski, Siberia
Russo-Asiatic Corporation, Ltd., Nerchinsk, Siberia
W. L. Reeder, Johannesburg, S. Africa
The Billiton Co., Tandjong Pandan, Billiton, Dutch East India
The Seoul Mining Co., Kobe, Japan
Takata & Co., 50 Church St., N. Y., For Japan
St. Anthony Mines, Lovelock, Nev.

The New Deister Simplex Rougher and Finisher

The Reason:

Note our duplex plateau. It consists of several steps or rises along a diagonal line intermediate the dressing zone and the main concentrating portion of the deck.

Numerous Repeat Orders for Deister Simplex Tables Prove That They Make Good

Recent re-orders totaling 381 Deister Simplex Sand Tables and 172 Deister Simplex Slime Tables tell a story of satisfaction complete. Just as the proof of the pudding is in the eating so is the proof of classifying machinery in its performance—in its ability to not only show superiority in comparative tests but to maintain that showing in prolonged service. That's where Deister Simplex equipment excels—in standing the racket, in large capacity, in economy of water, in automatic control of the line of separation, in cleaner concentrate and lower tailing.

The Deister Brothers, Emil and William F., are connected with this concern exclusively. The Deister Simplex Tables are the only ones that embody the latest and best Deister inventions.

Write us in detail concerning your ore concentration problem. We can offer suggestions based on years of field experience that will be helpful to you. No obligation.

Catalog on Request.

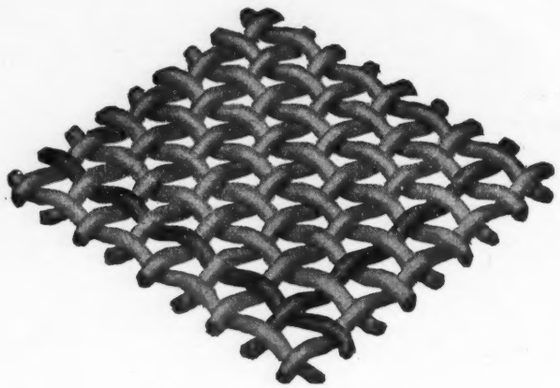
DEISTER MACHINE COMPANY

Incorporated July, 1912

Home Office and Factory:.....1933-2003 East Wayne St., Fort Wayne, Ind., U.S.A.
London Office:.....No. 1, London Wall Bldgs., London Wall, E. C.

Agents: William L. Reeder, 410 Consolidated Bldg., Johannesburg, South Africa. Takata & Company, 2 Yeirakucho, Nichome, Kojimachi-Ku, Tokyo, Japan.

SIMPLEX



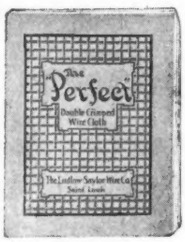
"Perfect" Means Maximum Screen Efficiency

There is no doubt but that some screens last longer than others and that some types of screens give better service than others.

The reason is plain: Some screens are made in a scientific way; they are constructed not "haphazard," but according to a principle.

This partly sums up the reason for the pre-eminence of "Perfect" Double Crimp Wire Cloth.

In the manufacture of "Perfect" Screens, quality is paramount. Only the very best material is used—Only wire made according to Ludlow-Saylor Specifications ever finds its way into "Perfect" Wire Cloth.



Spend the next minute and a half in writing for this interesting book about "Perfect" Wire Cloth.

This means longer life and uniform wear.

The Double Crimp, which is a feature of all "Perfect" Wire Cloth down to the finest mesh made, not only gives added strength and rigidity to the fabric, but it does away with slippage—the opening of some meshes and closing of others. The avoidance of this is important in close sizing.

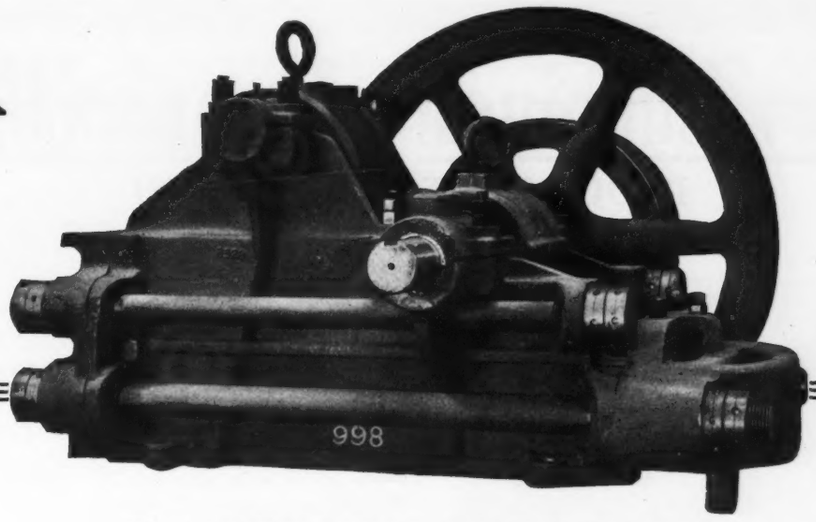
You will find that "Perfect" Wire Cloth is accurate in wire diameter, in mesh, in space—in fact you will find in it the result of our careful attention to small details as well as to the greater problems of manufacture, that accounts for the super-quality and super-efficiency of our product.

The Ludlow-Saylor Wire Co.

General Office and Factory, St. Louis, Mo.

BRANCH OFFICES—20 East Jackson Blvd., Chicago.
Mills Building, El Paso, Texas.
Felt Bldg., Salt Lake City, Utah.

"Perfect"



Side view of Blake Crusher with one fly wheel removed to show tension rods and other details of construction.

Buy this Blake Crusher for These Reasons—

(1) It is of light weight. Steel tension rods are used to take the severe crushing shocks. A light cast-iron frame holds the rods and bearings in line.

(2) Main frame of crusher cast in sections for convenience in handling, transportation and erection.

(3) Movable jaw type with chrome tempered steel jaw plates.

(4) Has safety toggle, which breaks when foreign material accidentally gets between jaws.

(5) Has two heavy machine-finished flywheels which make smooth running.

(6) Because this crusher is in wide use in concentrating mills, cyanide plants, stamp mills and smelters.

Bulletin No. 1056 goes more into details about it than is possible for us to do here. Ask us for a copy.

The Denver Engineering Works Co.

3100 Blake Street ***Also Makers of*** **Denver, Colorado**

Dewco Ball Mills
Ovoca Classifiers
Isbell Concentrators
Electric Hoists

Mine Timber Framing Machinery
Ore Crushers
Automatic Samplers

Richards Pulsator Classifiers
Richards Pulsator Riffles
Crushing Rolls
Mine Cages

Stamp Mills
Revolving Grizzlies
Sample Grinders
Dewco Tube Mills

DON'T BULL-DOZE YOUR BOULDERS

BLOCK-HOLE THEM WITH SULLIVAN HAMMER DRILLS

If you have many boulders to break, don't waste time and powder in bull-dozing or "mud-capping" them.

Block-Holed Boulders require one-fifth to one-tenth as much powder, and break up smaller.

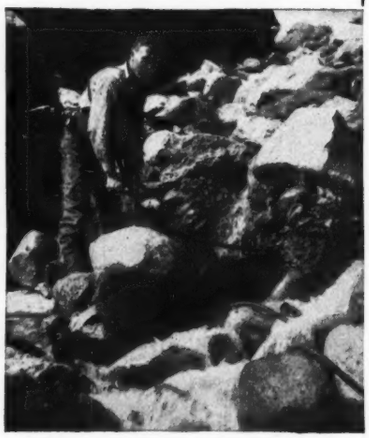
On Ruby Creek, British Columbia, a certain placer mine has to break over 20,000 boulders per season in its pit. . In 1913, the cost per boulder came to 36 cents.

In 1914, the mine installed a *Sullivan Belted Air Compressor* and *40-lb. Sullivan Hammer Drills,* at a total cost of $1,250. The use of these drills for block holing made a saving in the cost of explosives used, of $1,200 in 1914 and of $2,833.50 in 1915. Described in Mine and Quarry No. 231. *Ask for it.*

Another user of Sullivan Hammer Drills cut his block-holing cost from 30 to 14½ cents per boulder.

Hand block-holing is better than bull-dozing. Block-holing with Sullivan Hammer Drills is far faster and cheaper than either.

Ask for Bulletin 266L.



Sullivan Hammer Drill Block-holing, Ruby Creek, B. C.

SULLIVAN MACHINERY COMPANY

Boston
Butte
Cobalt, Ont.
Christiania
Denver
El Paso
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The Wedge Mechanical Furnace

Patented

Wedge Roasters Are Successfully Used at Various Plants in the United States, Canada and Mexico for:

Oxidizing roast of zinc ores;

Sweet-roasting gold ores for cyaniding;

Pre-roasting copper concentrates for smelter practice;

Drying-preheating and roasting copper concentrates for reverberatory treatment;

Chloridizing copper ores;

Chloridizing silver ores;

Dead-roasting iron ores;

Roasting lead ores and lead matte.

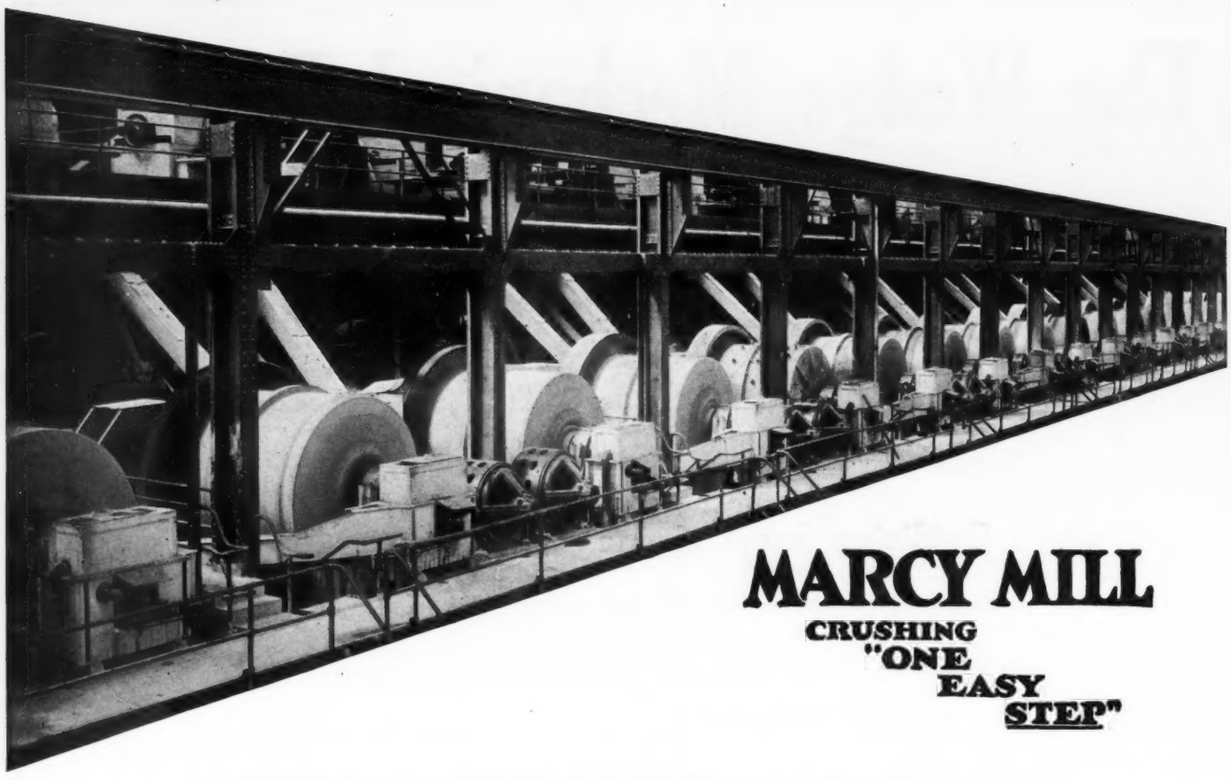
Special furnaces have also been developed for the treatment of complex ores.

The furnaces are modified in design and size, in each installation, adapted to the problem; hence desired results are secured at low operating cost.

Write us stating analysis of ore, concentrates, mixture or material you desire to roast, characteristics and physical condition of same, number of tons to be handled per twenty-four hours, and results desired in the calcine.

Wedge Mechanical Furnace Company

Greenwich Point, Philadelphia



One Big Concern has 44 in Operation

The Inspiration Consolidated Copper Company, Miami, Arizona, started out with 20 Marcy Ball Mills after they had made a searching investigation. More than that, **for crushing rock crusher product to flotation feed,** they did not decide on Marcy Ball Mills until they had conducted long and accurate tests with Rolls, Chilian Mills, many sizes and types of Conical Mills, Quick Discharge Tube Mills, Disc Crushers, Various Types of Roller Mills, High Speed Hammer Mills, etc.

Repeat orders have since come in from them until today they have 44 Marcy Ball Mills in operation, a portion of them being shown above.

The following concerns are also users of Marcy Ball Mills:

Magma Copper Co.
Braden Copper Co.
Duquesne M. & R. Co.
Arizona Copper Co.
Kennecott Copper Corporation, and many others.

Marcy Ball Mills are made in various sizes. They all deliver a finished product in "one easy step."

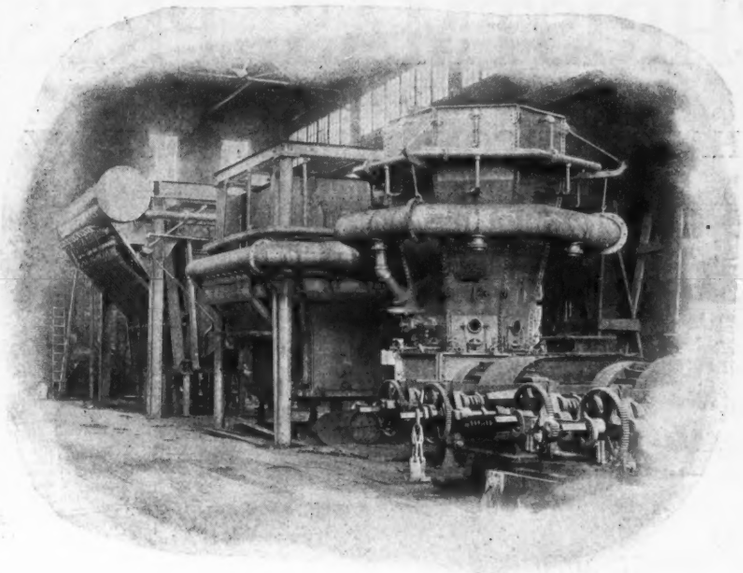
Why don't you profit by the experience and decision of these big, efficient, careful buying companies? The first step is to write and ask us to send you a copy of the "Marcy Mill Book."

The Mine and Smelter Supply Company

Denver Salt Lake City El Paso

42 Broadway, New York City

Copper Furnaces Built by



Colorado Iron Works Company

Investigate Direct Smelting

There is nothing mysterious or impossible about smelting; it is something about which the average operator can and should know—particularly direct smelting.

To concentrate and then smelt the concentrates—or have them smelted—where direct smelting is workable, is wasteful and expensive. The cost of the necessary smelting equipment will soon be paid for by the added saving. Do not neglect the possibility of direct smelting—*at least investigate.*

We Design and Equip Complete Smelting Plants

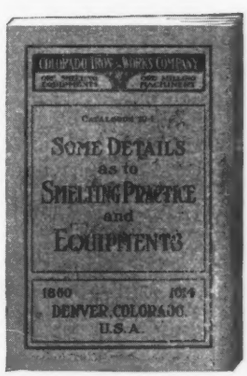
Smelting Equipment

Blast Furnaces
Reverberatory Smelting Furnaces
Copper Matting Furnaces
Roasting Furnaces
Cupelling Furnaces
Dust Chambers
Hot Blast Stoves
Forehearths
Slag Trucks
Matte Moulds

and give particular attention to smelting equipments of the size and range for the medium-sized company and individual operator. We have built smelting equipment ever since blast furnace smelting was first developed in this country. We have designed and equipped many smelting plants of varying sizes and for all classes of smelting.

You will find our "Smelting Practice" Bulletin Valuable

It is a book of 160 pages, covering the metallurgical principles which underlie the recovery of lead, copper, gold and silver by fire methods, and a description of the apparatus by which it is done. **Write for a copy.**



COLORADO IRON WORKS COMPANY

-1860- DENVER COLORADO -1916-

A CHRISTMAS PRESENT

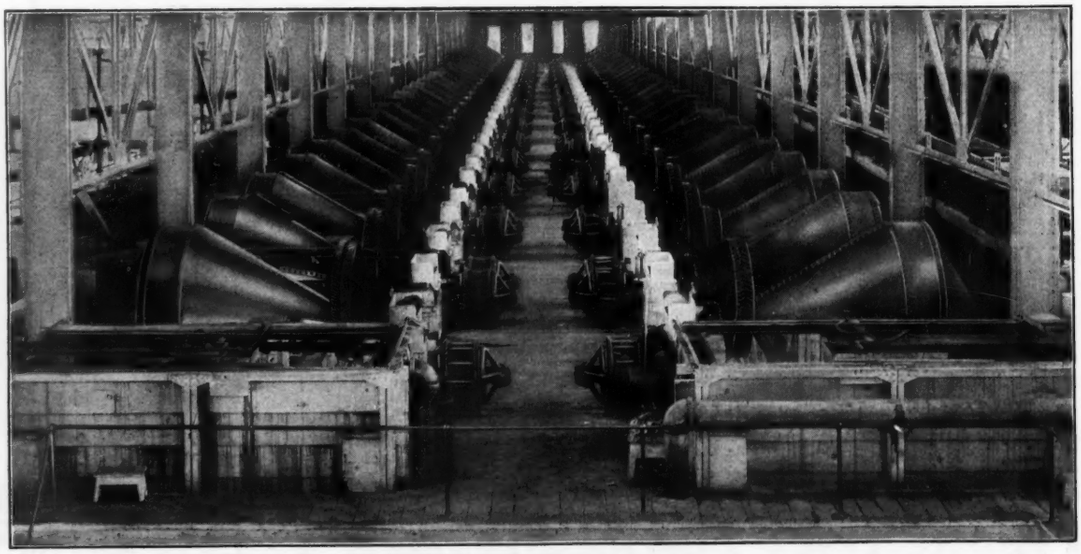
TO THE

HARDINGE CONICAL MILL COMPANY

HOLIDAY GREETING TELEGRAMS
Will be delivered on Special Forms
By WESTERN UNION
WESTERN UNION
TELEGRAM
CLASS OF SERVICE
Day Message
Day Letter
Night Message
Night Letter
If none of these three symbols appears after the check (number of words) this is a day message. Otherwise its character is indicated by the symbol appearing after the check.
ST. (STOCK EXCHANGE BLDG.), NEW YORK ALWAYS OPEN
7 OCH AA 11 CALUMET MICH 853 AM DEC 20 1916
HARDINGE CONICAL MILL CO
120 BROADWAY NEW YORK
YOUR PROPOSAL FOR TWENTY TWO CONICAL MILLS ACCEPTED ORDER MAILED TODAY.
CALUMET & HECLA MINING CO
10 02 AM
RECEIVED
HARDINGE CONICAL MILL CO.
NEW YORK
DEC 20 1916
Rec'd by
Date 12/20/16
Action taken Order Entered

We quote from the Engineering and Mining Journal, issue of Nov. 4: "Calumet and Hecla (Michigan)—No. 1 regrinding plant, formerly equipped with old style Chilean Mills, is to have Hardinge Mills for regrinding sands. Each conical mill installed will replace two Chilean mills."

This company has in operation more than 100 Hardinge mills.



64-8-FT. DIAMETER HARDINGE CONICAL MILLS.
(Operated by 2 men per shift.)
Driven by 40 hp. General Electric Motors.

The New Mill Addition
to the
Embree Iron Company's Plant
Embreeville, Tenn.

Will be completely equipped with *Our Tables* for treating Carbonate of zinc ores.

July 28, 1915 — **11 Tables Installed**
Nov. 24, 1916 — **9 Additional Tables**

Do not overlook our special ad. in January 6th issue.

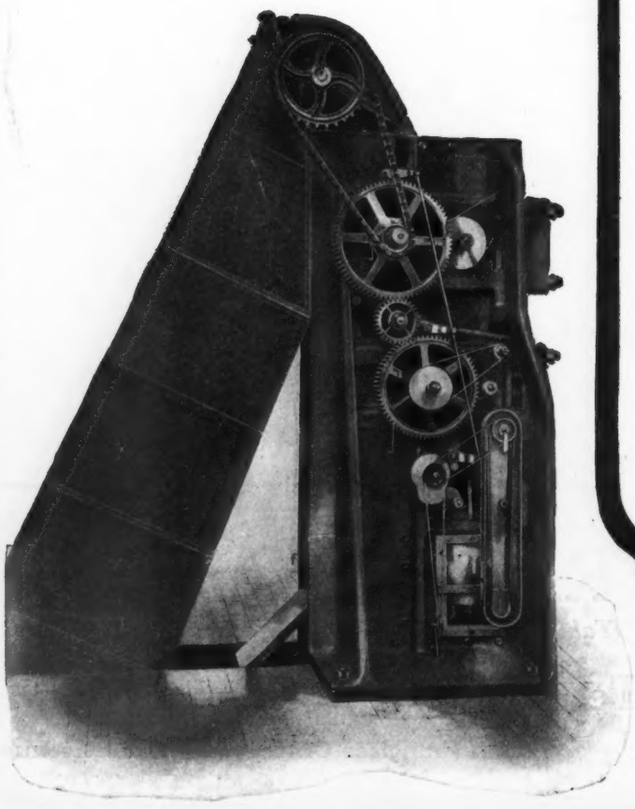
The
Deister CONCENTRATOR Company
Manufacturers of DEISTER and OVERSTROM Tables in either Single or Double Deck Types

Main Office, Factory and Test Plant—Ft. Wayne, Ind.

Denver Office, 1718-1720 California Street — **San Francisco Office: 75 Fremont Avenue**

With the CLIFTS Automatic Crushing and Sampling Machine—You save all along the line

Save Space
Save Power
Save Labor
Save Time
Save Belts
Save Handling
Save Costs



To the mine manager who is alive to the inefficiency of the average sampling plant, a study of the Clifts Automatic Crushing and Sampling Machine will prove a revelation.

He will learn that the Clifts combines three samplers with three sets of rolls in one machine.

He will learn that it prepares the sample for the laboratory, eliminating the personal element from all operations.

He will learn that it is very compact, requiring neither high nor expensive building—

That it reduces the number of driving belts to the minimum—

That it has no expensive ore chutes or pipes to wear out—

That it will handle the ore either wet or dry, without dividing or quartering the ore by hand—

That it will reduce the time and labor occupied in sampling a lot of ore by four-fifths, as compared with the hand method—incidentally, doing the work more thoroughly and accurately than is possible by hand—

And he will learn other features of the Clifts that are equally desirable.

If you are that mine manager, or if you are at all interested in the cause of greater efficiency and economy in the sampling plant you will be serving your best interests if you send for Bulletin CS-1 today.

Traylor Engineering & Manufacturing Co.

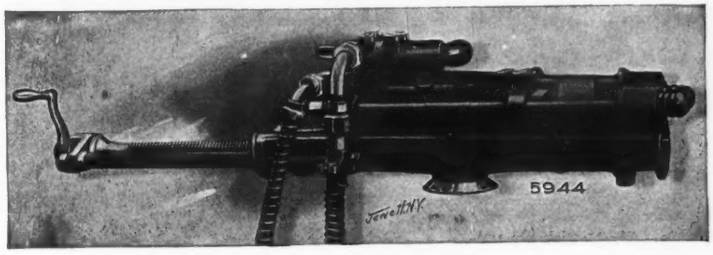
Main Office and Works,
Allentown, Pa., U. S. A.
New York Office, 34 Church Street
Western Office, Salt Lake City, Utah.

THE ROCK IN THIS TUNNEL

is probably the hardest ever encountered in rock drilling.

And yet, two "Leyner-Ingersoll" Drills established the remarkable record of 437 feet in 81 eight hour shifts.

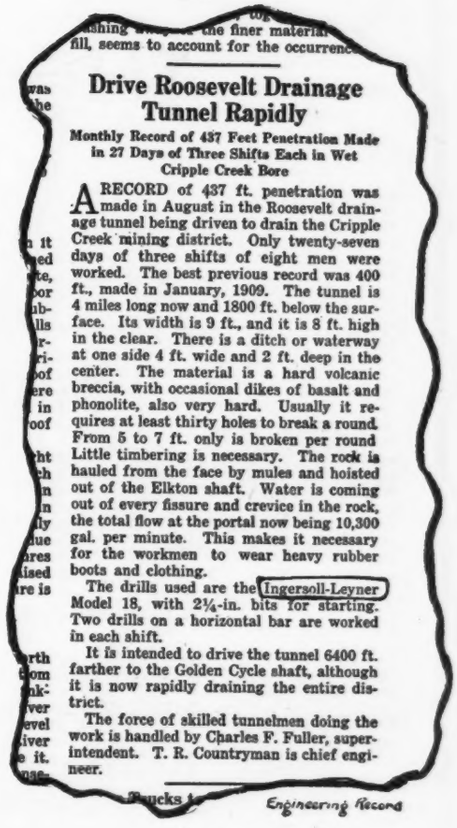
This tunnel is now 4 miles long and lies 1,800 feet below the surface. Size of heading 9 feet x 8 feet.



This tunnel was originally started in 1907. Early attempts to drive it were abandoned by several contractors owing to their inability to drill the hard rock economically. A new contractor installed Leyner drills and no further difficulty was experienced.

The "Leyner-Ingersoll" Drill has demonstrated in miles of tunnel and drift work, its ability to drill all kinds of rock, not only rapidly but at a low cost.

Ask for Bulletin 4122.



fill, seems to account for the occurrence.

Drive Roosevelt Drainage Tunnel Rapidly

Monthly Record of 437 Feet Penetration Made in 27 Days of Three Shifts Each in Wet Cripple Creek Bore

A RECORD of 437 ft. penetration was made in August in the Roosevelt drainage tunnel being driven to drain the Cripple Creek mining district. Only twenty-seven days of three shifts of eight men were worked. The best previous record was 400 ft., made in January, 1909. The tunnel is 4 miles long now and 1800 ft. below the surface. Its width is 9 ft., and it is 8 ft. high in the clear. There is a ditch or waterway at one side 4 ft. wide and 2 ft. deep in the center. The material is a hard volcanic breccia, with occasional dikes of basalt and phonolite, also very hard. Usually it requires at least thirty holes to break a round. From 5 to 7 ft. only is broken per round. Little timbering is necessary. The rock is hauled from the face by mules and hoisted out of the Elkton shaft. Water is coming out of every fissure and crevice in the rock, the total flow at the portal now being 10,300 gal. per minute. This makes it necessary for the workmen to wear heavy rubber boots and clothing.

The drills used are the Ingersoll-Leyner Model 18, with 2¼-in. bits for starting. Two drills on a horizontal bar are worked in each shift.

It is intended to drive the tunnel 6400 ft. farther to the Golden Cycle shaft, although it is now rapidly draining the entire district.

The force of skilled tunnelmen doing the work is handled by Charles F. Fuller, superintendent. T. R. Countryman is chief engineer.

Engineering Record

49-LI

INGERSOLL-RAND COMPANY

11 Broadway NEW YORK

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165 Q. Victoria St. LONDON

FOR CANADA ADDRESS—CANADIAN INGERSOLL-RAND CO., MONTREAL.

AIR COMPRESSORS
VACUUM PUMPS
TURBO BLOWERS
"JACKHAMERS"
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$14=Added value
3= " treatment
——— charge
$11=Net increased
value per ton

A Huff Electrostatic Separator Did It

From a 4% copper and 50% zinc middling, the Huff produced a 17% copper and 60% zinc product, thereby raising the value of the concentrate, on present market prices, from $43 per ton to $57 per ton. This was done at an added treating cost of $3 per ton.

With spelter at 5 cents and copper at 15 cents, the net increase in value of the product would have been over $6.

It will pay you to see what the Huff can do with your zinc-copper and zinc-iron middlings. Its capacity for making a more marketable product is remarkable. Our 50 ton Denver Mill is equipped to make thorough and conclusive tests on car-load lots. Write.

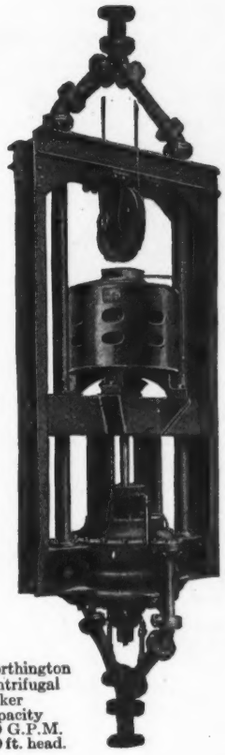
Also the Plumb Pneumatic Jig

American Zinc Ore Separating Co.

1218 Foster Building, Denver, Colorado

WORTHINGTON

Centrifugal Mine Pumps



Worthington Centrifugal Sinker Capacity 500 G.P.M. 350 ft. head.

Where conditions demand a centrifugal, select a Worthington Pump.

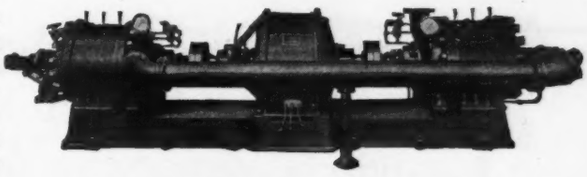
These illustrations show several Worthington designs that have proven exceptionally well-fitted to mining application.

The Worthington Pump is sturdily and dependably constructed—designed to meet your specific conditions of service.

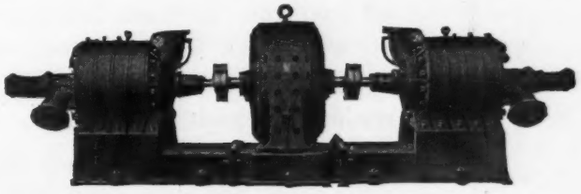
The Worthington Pump requires comparatively small space; its extreme simplicity, low first cost, infrequent repairs, low upkeep and high efficiency are appealing features to the mining engineer—features the right mine pump *must* possess.

That is why Worthington Centrifugal Mine Pumps may be found in operation in nearly all the important mining regions in the United States and Mexico.

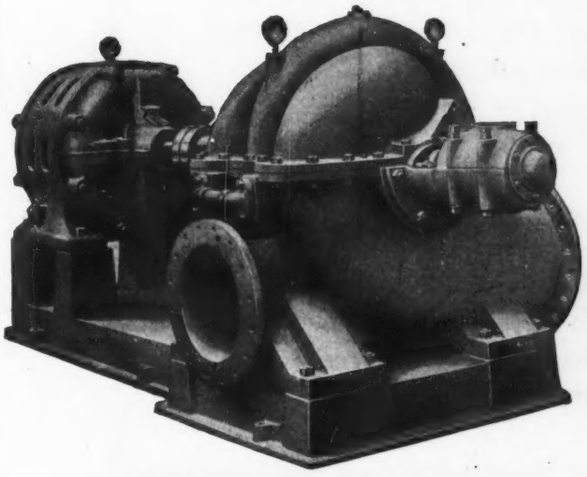
When the water to be handled contains acid in solution, the entire pump is constructed of acid resisting composition; otherwise, the casing is built either of steel or heavy cast iron. Bronze impellers are always used for high-speed pumps.



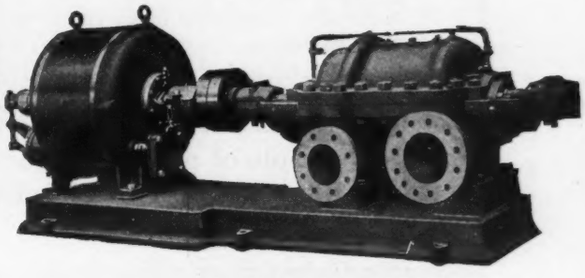
8 in. 8-stage Motor Driven Turbine Mine Pump. 900 G.P.M. 1,250 in. 450-HP. Motor.



10 in. 10-stage Centrifugal for Hydraulic Mining. 4 Units, each 3,000,000 gal. per 24 hr., 750 ft. head.



16 in. Double-Suction Split Casing Volute Pump.



10 in. 4-stage Turbine, 4,000 G.P.M. 500 ft. head.

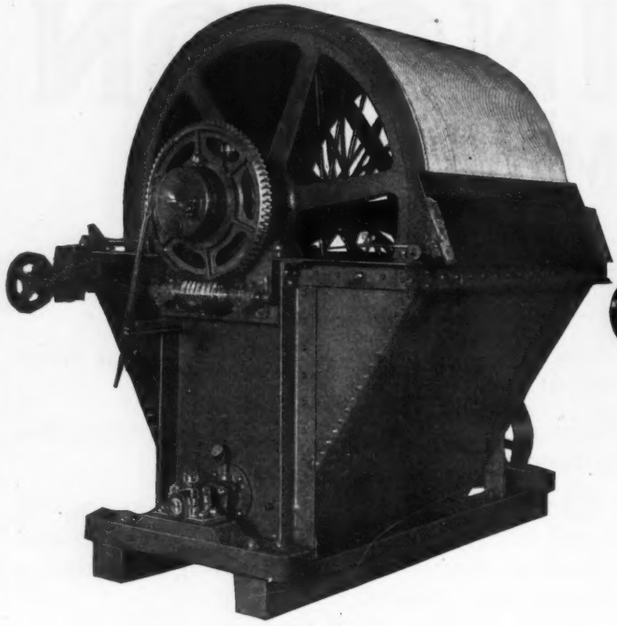
WORTHINGTON PUMP AND MACHINERY CORPORATION

New York Office: 115 Broadway **Works: Harrison, New Jersey**

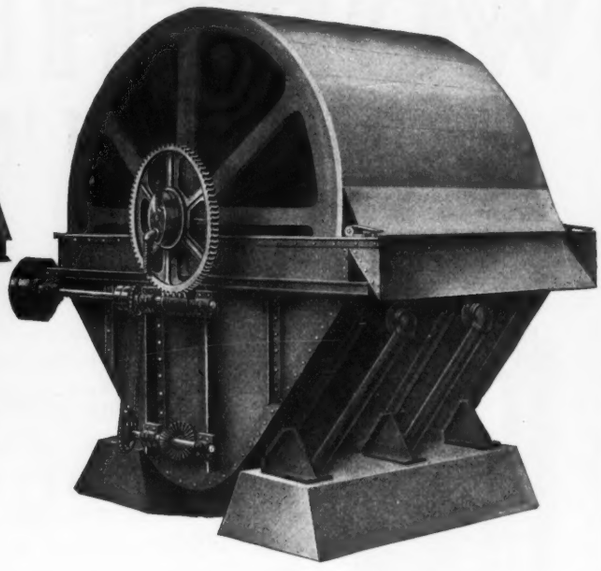
Branch Houses:

Atlanta, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Denver, Detroit, El Paso, Kansas City, Los Angeles, New Orleans, Philadelphia, Pittsburgh, St. Louis, St. Paul, Salt Lake City, San Francisco, Seattle

W321.8



Small Olivers.



Large Olivers.

The Oliver Continuous Filter

is simple and its mechanical construction is of the best. Hence its capacity for standing up under hard work and for keeping on the job without shutdown. An Oliver Filter is all business. You get full protection without paying royalties. It will work 24 hours out of the day without attention. There are no tanks to empty, no valves to take up your time, no heavy leaves to fool with. **It is automatic.**

This is the way a mill man who has had occasion to observe the Oliver Filter closely and under a very wide range of service, put it recently:

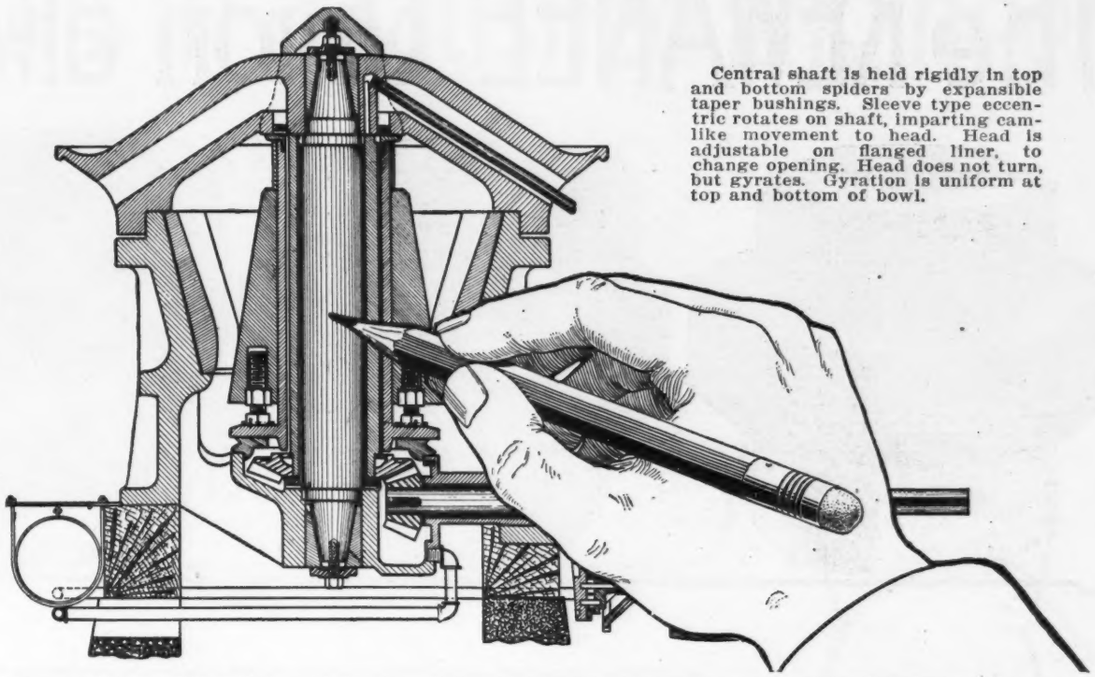
Dewatering to as low as 6 and 7%, it saves freight; operating automatically, it reduces labor costs—no scraping, mucking out or intermittent operation. It also minimizes soluble losses in cyaniding. Descriptive bulletins on request.

We should particularly like to have you send us a 5 gallon sample of pulp for laboratory test. The results will tell the exact story. No charges.

Oliver Continuous Filter Company

800 Hooker and Lent Building, San Francisco, California

No Royalties—Low First Cost



Central shaft is held rigidly in top and bottom spiders by expansible taper bushings. Sleeve type eccentric rotates on shaft, imparting cam-like movement to head. Head is adjustable on flanged liner, to change opening. Head does not turn, but gyrates. Gyration is uniform at top and bottom of bowl.

We Are Building Four No. 7½ Telsmith Primary Breakers For The Braden Copper Company

WHY? Because, in heavy crushing service, the short, stocky, single-piece Telsmith frame is vastly more reliable than a two-piece frame of twice the height.

Because the Telsmith shaft is rigid, instead of merely supported—because it is shorter and stronger—because it is uniformly loaded and non-fatiguing—because it clamps the whole crusher structure together.

Because the bearings are bigger—between 3 and 4 times bigger than in other gyratory breakers.

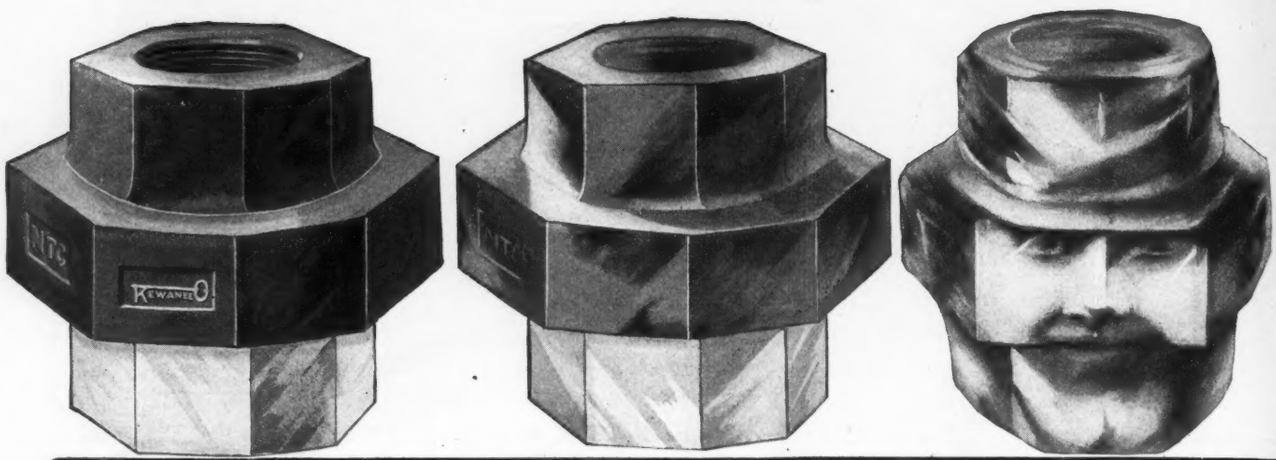
Because the stroke is parallel to the axis of the crusher—because there's a long initial pinch on the big rocks—because the entire bowl is utilized, instead of only the bottom.

Because all gears and bearings are protected by oil pressure, which absolutely precludes the entry of dirt.

For the same "becauses," you will be interested in our catalog No. 168-M which we will gladly send without charge or obligation.

SMITH ENGINEERING WORKS
3195M LOCUST ST. - - MILWAUKEE

The "KEWANEE" Union always



KEWA

¶ Engineers who have been using ordinary unions notice the difference—and show it—when they switch over to "KEWANEE" Unions.

¶ The adoption of "KEWANEE" Unions eliminates trouble and changes a grouch to a grin. The superior "KEWANEE" qualities quickly bring the smile of solid satisfaction to the face of every user.

¶ There's not the slightest doubt about it—

¶ The "KEWANEE" Union always results in a satisfied engineer.

NATIONAL TUBE COMPANY

General Sales Offices: Frick Building, Pittsburgh, Pa.

results in a satisfied Engineer

NEE O

Don't Forget These Five "KEWANEE" Advantages:

(1) Brass to iron thread connection—No corrosion.

(2) Brass to iron ball joint seat—No gasket.

(3) Extreme compressed air test under water—No defective fittings.

(4) Solid three-piece construction—No inserted parts.

(5) Easily connected and disconnected—No force required.

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Pacific Coast Representatives: U. S. STEEL PRODUCTS CO., San Francisco, Los Angeles Portland, Seattle.

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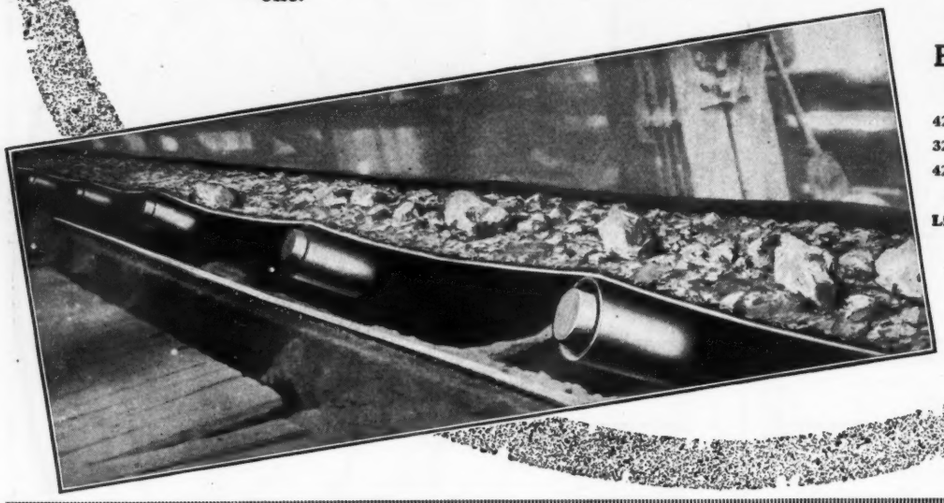
REXALL

–the Conveyor Belt that Lasts

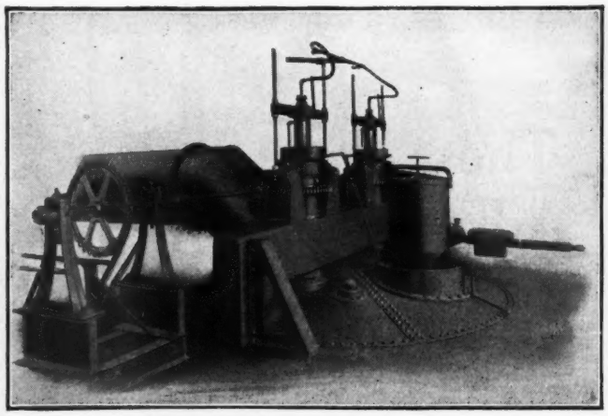
There is nothing mysterious about the lasting quality of "Rexall" Canvas Belting. Its double stitched construction prevents ply separation and the superior quality of duck used insures maximum wear. Special chemical treatment renders it pliable at all times and makes it impervious to moisture and to changes in temperature. You'll be interested in examining a sample. Write for one.

Write for Full Details and Prices.

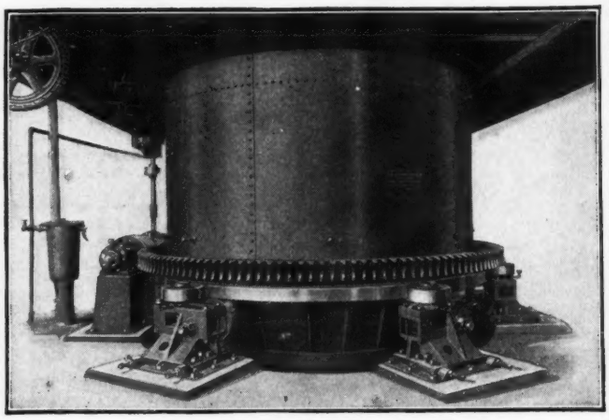


IMPERIAL BELTING CO.
MANUFACTURERS
SALES OFFICES
42 Broadway, New York City
325 Walker Bank Bldg., Salt Lake City
423 Yeon Bldg., Portland, Ore.
GEN'L OFFICES AND FACTORY
Lincoln and Kinzie Streets CHICAGO

Continuous Gasification Without Hand Poking or Clinker Formation



Stationary Section showing Stirring Gear.



Revolving Section showing Worm Gear Drive.

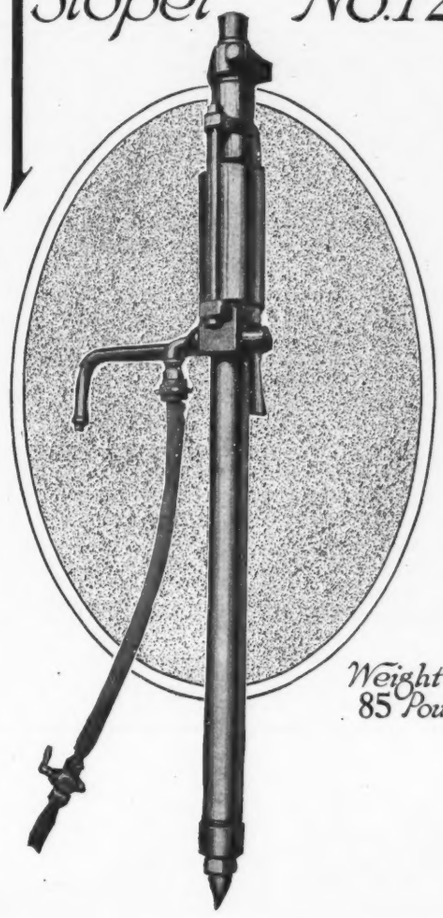
WOOD Mechanically Operated GAS PRODUCERS

Produce a continuous gas supply with from 26 to 28% CO content. Unexcelled for operation in connection with zinc smelting and Roasting Furnaces. In use by American Zinc and Chemical Co., Grasselli Chemical Co., American Zinc, Lead and Smelting Co. Highly economical. Low steam and water consumption. Write for complete information now.

R. D. WOOD & COMPANY - - PHILADELPHIA, PENNA.

Makers of Hydraulic Machinery, Gas Holders, Centrifugal Pumps, Cast Iron Pipe, Fittings, Valves and Special Castings.

HARDSOCG Stoper No. 12



Weight 85 Pounds

We Guarantee—

¶ That the Hardsocg Stoper is constructed of the best material for rock drills and that it will give longer service and better all-round results.

¶ That, being valveless, it is most economical.

¶ That it will consume less air than other drills having same size cylinder.

¶ And that it will drill more feet of holes on the same amount of air.

Want full details concerning the exceptional drilling speed and durability of the Hardsocg No. 12? Write for catalog.

Hardsocg Wonder Drill Co.
Ottumwa, Iowa
Agencies in all Principal Cities

DENVER "CLIPPER" DRILLS
and
"WAUGH" STOPERS
Prove to be a Strong Combination

Butte & Superior Mining Company
Headway made on Shafts No. 2 and 3

Shaft No. 3

Work was begun on this shaft in December, 1915. This shaft was sunk to a depth of 65 feet in January, 1916. February 1st, Denver "Clipper" Drills were installed and an average of 125 feet per month was sunk until the shaft was connected at a depth of 690 feet July 1st, 1916, with a series of raises driven from the 10-, 12-, 13-, 1,400-ft. levels with Waugh Stopers. On August 1st connection was made from the 15- to 1,400-ft. levels.

Four miners per shift were employed in the shaft using four Denver "Clipper" Drills. A round consisted of twenty-six 8-foot holes.

Raising was done with two 17-V "Waugh" Stopers drilling rounds of 16 holes to a depth of 6 feet. Raises timbered with full size (6x18 ft.) three compartment shaft sets.

Maximum Sink 135 ft. in 30 days.

Maximum Raise 100 ft. in 14 days.

Shaft No. 2

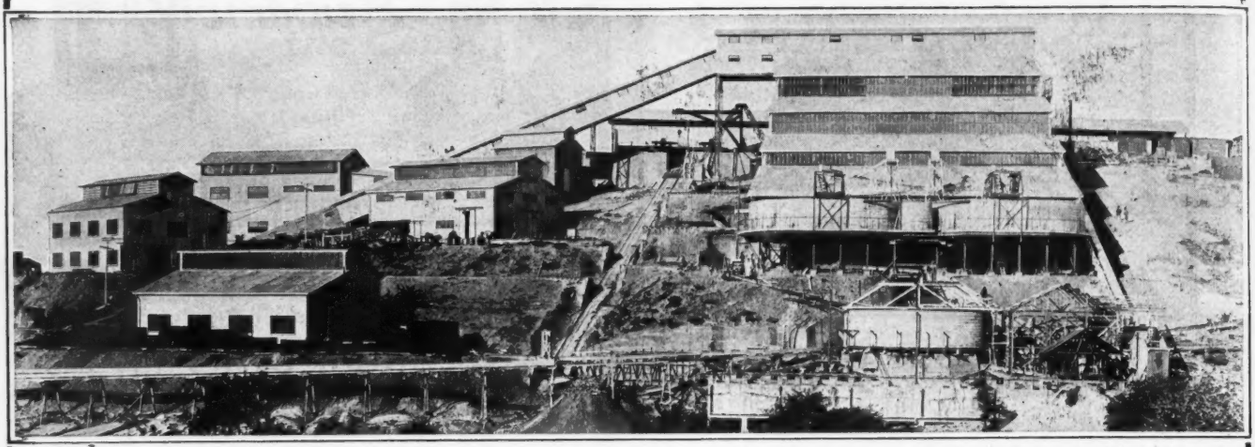
Eight by eighteen, three compartments. Sunk to 600 ft. depth. Completed by raising. Shafts fifty feet apart.

Formation: Stiff granite.

THE Denver Rock Drill Manufacturing Co.
DENVER, COLO.

New York El Paso Seattle Salt Lake City
San Francisco Houghton Butte, Joplin Kingman, Ariz.
CANADIAN ROCK DRILL CO., Ltd., Toronto, Ont., Nelson, B. C.

Butchart Concentrating Tables

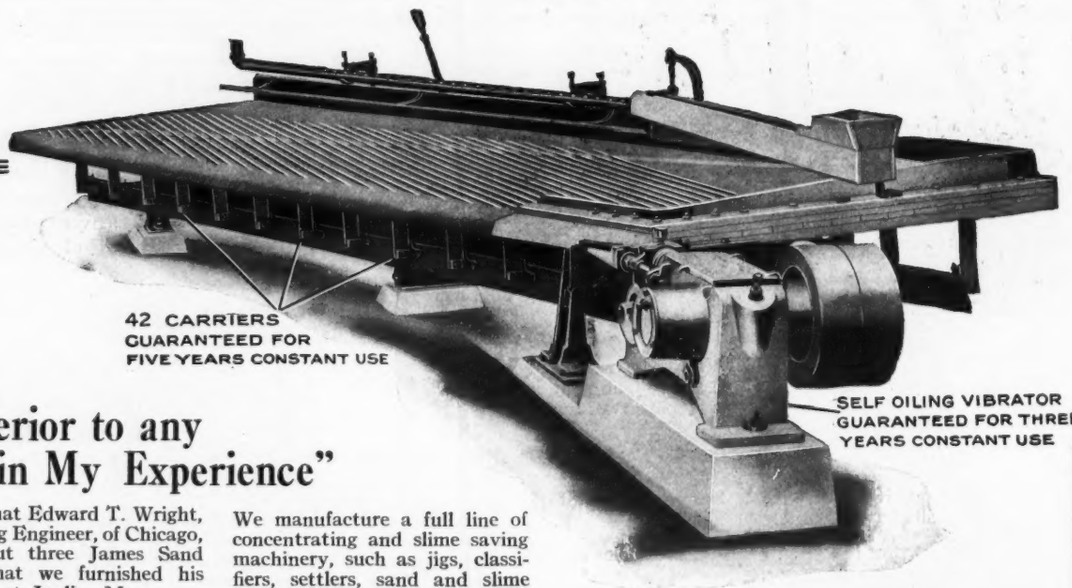


are the exclusive table equipment of the Burro Mountain Copper Co., Tyrone, New Mexico, a Phelps, Dodge & Co. property. This is one of the most modern and up-to-date plants in the United States.

Why not adopt BUTCHART TABLES for YOUR new mill?

Write for Bulletin No. 2. Submit your concentration problems.

W. A. Butchart, 605-607 Mercantile Bldg., Denver, Colo.



"Superior to any Within My Experience"

This is what Edward T. Wright, Consulting Engineer, of Chicago, says about three James Sand Tables that we furnished his company at Joplin, Mo.

James Tables are in successful operation throughout the world—over 1,500 in America. One concern in Missouri has forty-five.

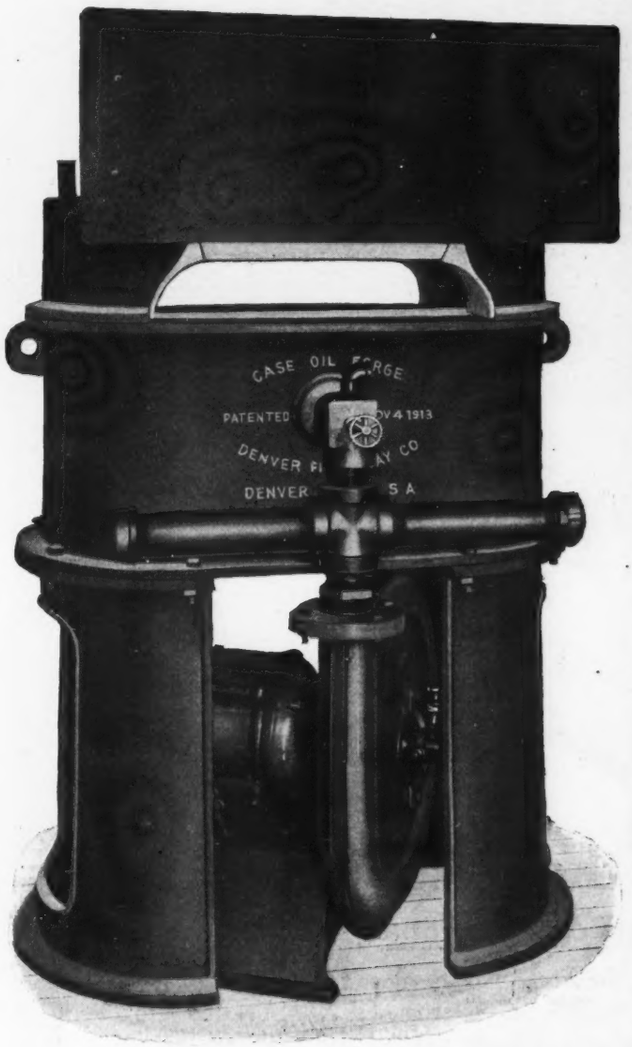
We manufacture a full line of concentrating and slime saving machinery, such as jigs, classifiers, settlers, sand and slime tables, and screens for both wet and dry work. We make tests on all concentrating ores and design and equip concentrating plants complete.

Write for Descriptive Circulars and Prices.

THE JAMES ORE CONCENTRATOR COMPANY
35 Runyon Street - - - Newark, N. J., U. S. A.
and HOLMAN BROTHERS, LIMITED
Camborne - - - - Cornwall, England

JAMES CONCENTRATING MACHINERY

Saves Time, Steel, Fuel and Labor



Fuel Oil Burning
Low Pressure
FORGE

Write for the latest Forge Bulletin

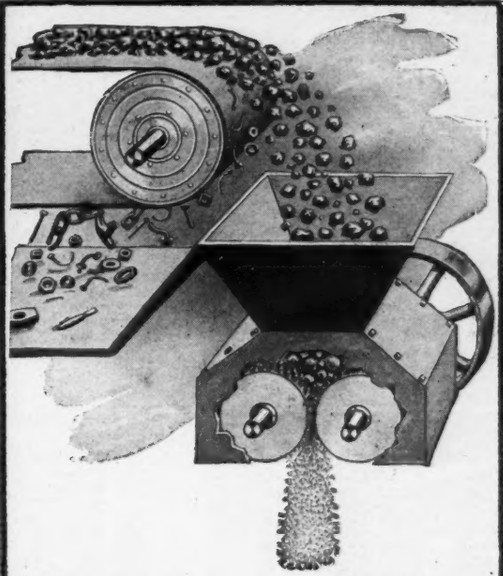
DENVER
FIRE CLAY CO
PRODUCT

HAVE SURVIVAL VALUE

- Fuel oil flame quickly heats forge—can be instantly extinguished.
- Steel in sight at all times—no burning.
- Flame does not sulphurize or scale steel.
- Complete fuel combustion — no smoke.
- Low pressure—practically no noise.
- Saves 10% steel and 20 to 40% fuel.

Denver Fire Clay Company
Denver, Colorado, U. S. A.

Dings
Magnetic Pulleys



What Happens to Your Plant When Your Crusher Breaks?

Do things continue to go well? No indeed they don't! There is a stoppage all down the line. Sometimes it's brief—sometimes prolonged—depending on the seriousness of the damage. The point is, delays are expensive. So much so that only a few of them more than offset the cost of one of our magnetic pulleys. And that is not considering actual costs of crusher repairs, to say nothing of the lowering of plant efficiency.

By introducing a Dings Magnetic Pulley as Head Pulley for your belt conveyor you provide a magnetic separator that will remove all tramp metal from crusher material and insure against damage. Made in all sizes. Full details and prices on request. Write.

Dings Magnetic Separator Co.
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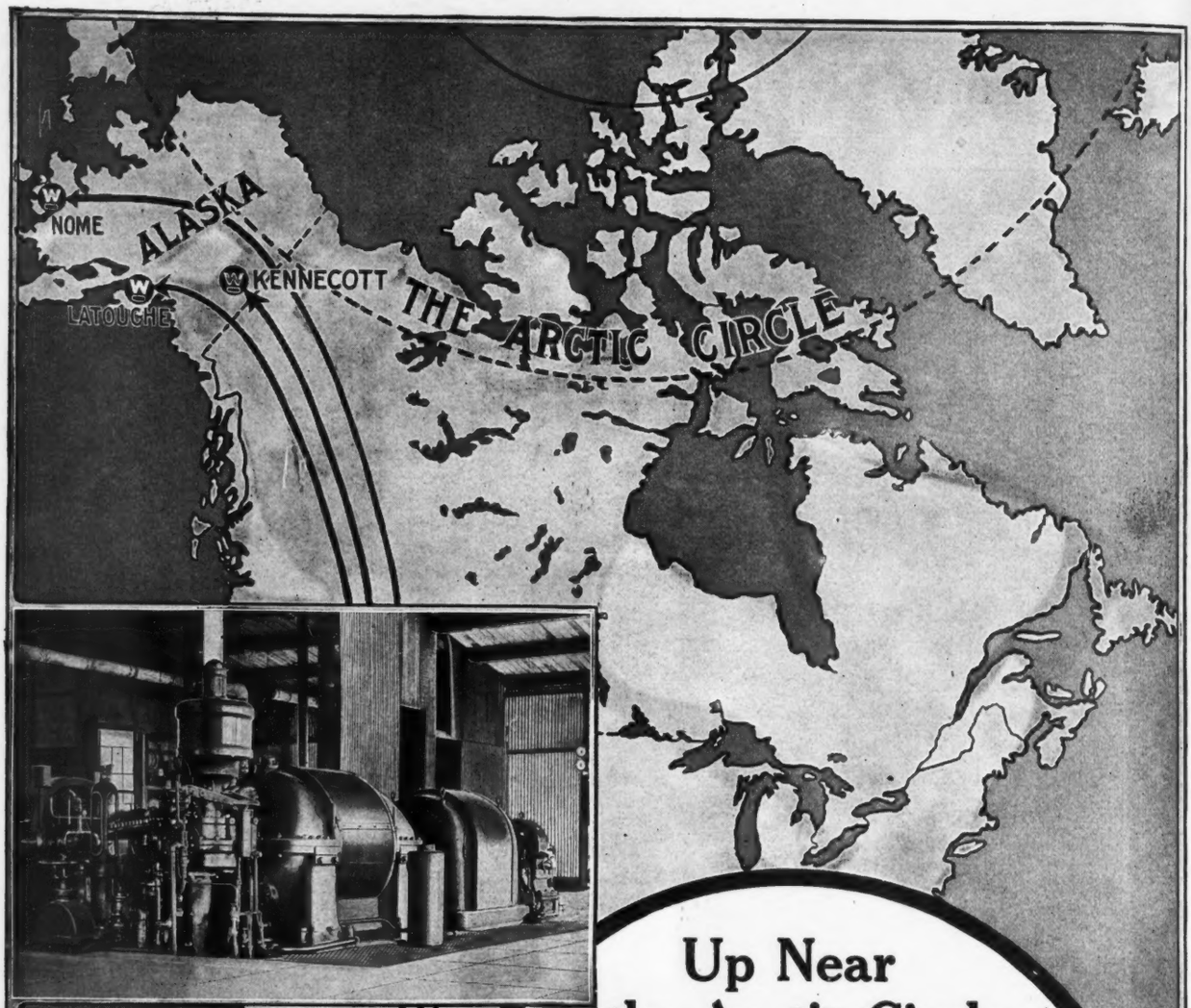
Dings
Magnetics Separators



Up Near the Arctic Circle

Kennecott ***Nome*** ***Latouche***

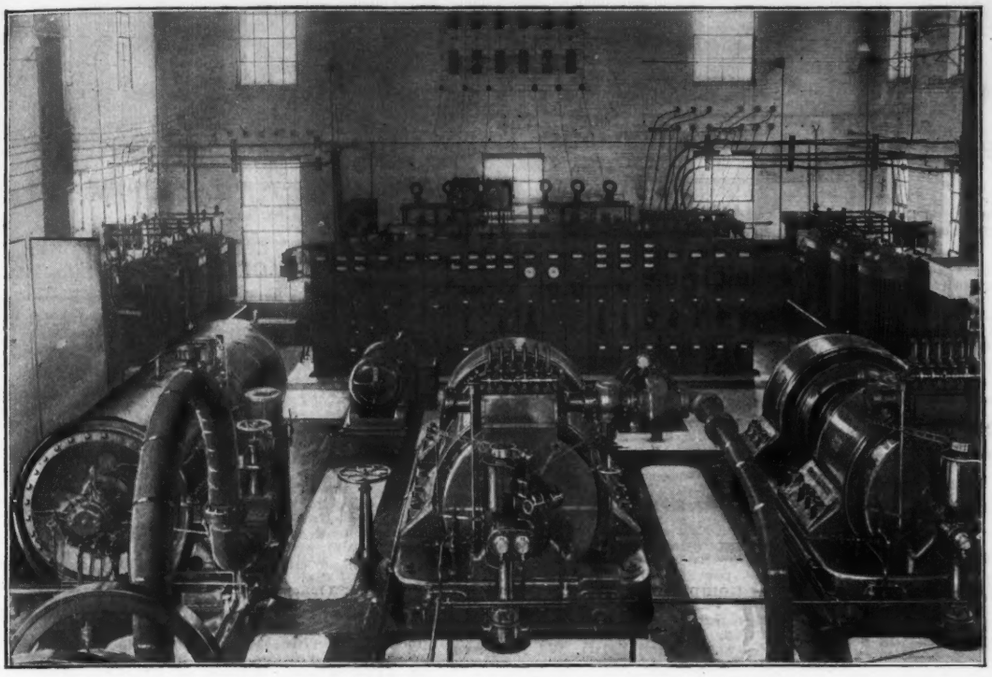
Up in the frozen North—near the Arctic Circle—WESTINGHOUSE TURBO-GENERATORS are operating satisfactorily year in and year out—in a service and a locality where operating troubles could not be tolerated—where repairs would mean prohibitive delay and expense.

The Kennecott Copper Corporation and the Nome Consolidated Dredging Co. selected Westinghouse Steam Turbines because of their PROVEN RELIABILITY.

Westinghouse Electric & Mfg. Co.
East Pittsburgh, Pa.

W WESTINGHOUSE ELECTRIC

Westinghouse



Central Power Plant, Davis Coal and Coke Co., Thomas, W. Va.

Greatly Increased Tonnage for Less Power

By using one power plant for a group of mines instead of a power plant at each mine, a greatly increased tonnage has been obtained by a well-known mining syndicate.

Much less fuel per ton of coal extracted is required and greater continuity of power assured than before centralization.

Turbo-generators and motors made by the General Electric Company were used in making the above change, which has proven so profitable. Probably centralization of power plants may work economies for you.

This trade mark the guarantee of excellence on Goods Electrical

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General Electric Company

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6623

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FURNACE FOREMAN wanted for copper mine in Venezuela; take charge single blast furnace, preferably experienced pyritic smelting; able speak Spanish; also chemist for above. Reply stating experience and terms.. P492—Eng. & Min. Journal.

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Examinations for these positions will be held on or up to the dates given.

For information on the following, write to United States Civil Service Commission, Washington, D. C.:

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SUPERVISING MINING ENGINEER and metallurgist; $4,000; examination Jan. 16. Form 2118.

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The Agencies advertising here agree to refund any registration fee on demand any time within the first six months when no position is secured.

MECHANICAL DRAFTSMEN—Several men experienced on mill and smelter design; liberal salaries. Business Men's Clearing House, Denver, Colo.

NO REGISTRATION FEE is charged our clients; so are under no obligation to place unqualified men. Registrations accepted from desirable applicants only; so offer mining companies carefully selected men whose records warrant our recommendation. When requiring capable men of any kind write Mines Technical Agency, 1004 Washington Building, Los Angeles.

TEMPORARY FREE REGISTRATION —While present heavy demand continues for well-qualified men all branches mining, milling, smelting, we will accept, without registration charge, applications from mining men who are technical graduates; desirable positions secured promptly; established 14 years. Business Men's Clearing House, Denver, Colo.

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"Positions Wanted," 3 cents a word, minimum charge 50 cents an insertion, payable in advance.

"Positions Open" and all other undisplayed Want and For Sale advertisements, 5 cents a word, minimum charge $1 an insertion.

(When replies are to be received in our care, allow four words for the box address.)

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CORRESPONDENT

THE UNDERSIGNED plans and conducts correspondence for positions in technical, manufacturing and professional lines for $2,500 to $15,000 men exclusively. Complete privacy assured. No commission charged—only service fee and postage. Send name and address only, in confidence, for prefatory details. R. W. Bixby (established 1910), W1 Niagara Square, Buffalo, N. Y.

Positions Wanted

MINING GRADUATE seeks position with strong company desiring a man with six years' experience in surveying, underground, cyanide and construction work under widely varied conditions. Speak Spanish. PW486—Eng. & Min. Journal, Chicago.

EXPERIENCED MINE ACCOUNTANT, gold, iron and silver mines, requires position; languages, French and Greek; single. PW488—Eng. & Min. Journal.

METALLURGIST with many years' experience as superintendent and metallurgist of zinc smelting and silver-lead smelting plants with large companies is open for engagement; technical graduate; good references. PW489—Eng. & Min. Journal, Chicago.

MANAGER or SUPERINTENDENT; open for engagement; with a technical training and 25 years' of continuous service, on the principal mining fields in the Western States and Foreign Countries; claim to understand every phase of mining, milling, construction and installation of equipment, applicable to latest practice. Highest credentials. PW 485—Eng. & Min. Journal.

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Steam up to 1,000 H. P.

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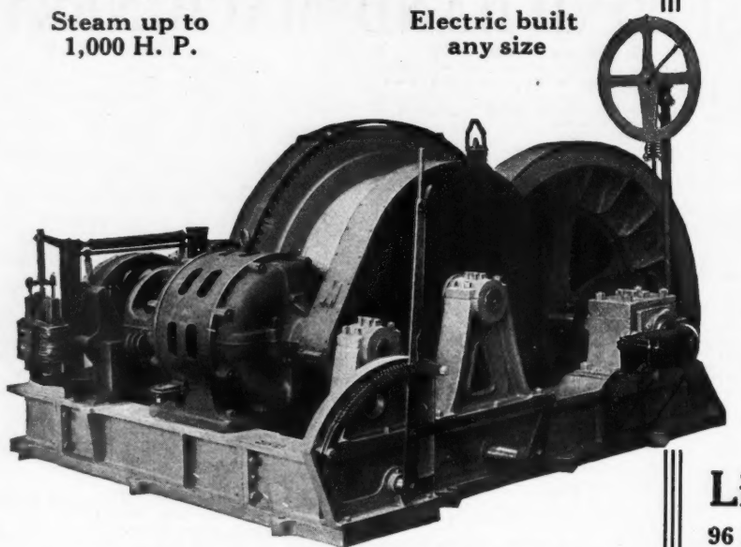

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Safety, Capacity, Durability

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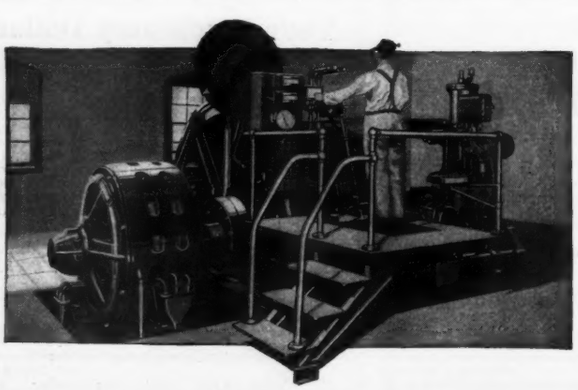

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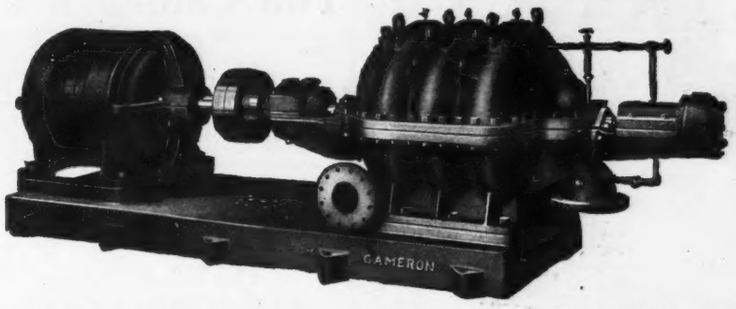

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Mining men have found that the sure way to secure pump efficiency and economy is to install Cameron Centrifugal Pumps.

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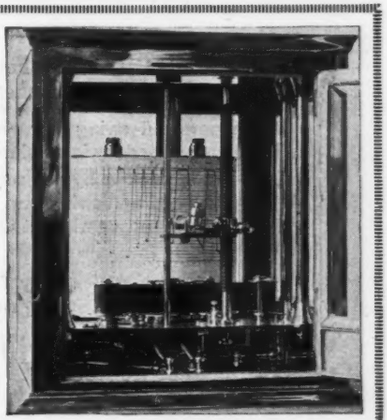

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For hoisting timber up chutes, stopes and shafts.

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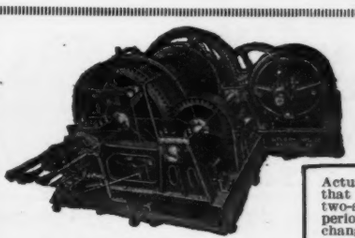

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Number four: Mechanism far superior to the clutch pinion type of changing speed

Actual usage has demonstrated that the mechanism in this Flory two-speed Mine Hoist is far superior to the clutch pinion of changing speed—

Reason for the universal demand for this hoist—

And for the fact that several orders for hoists of the clutch pinion type have been cancelled and Flory two-speed Werner Band Friction Hoists substituted.

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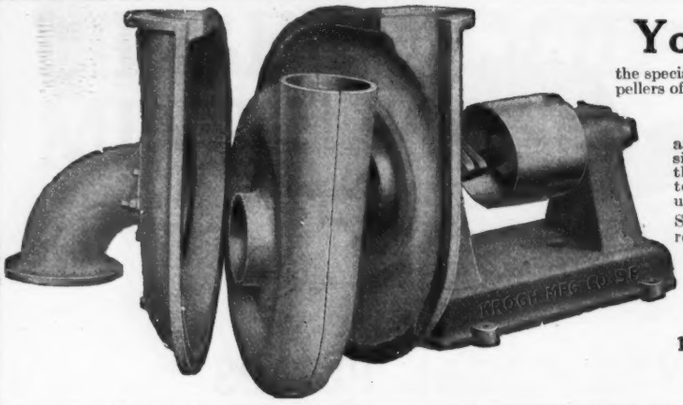

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the specially chilled car wheel iron of which the liners and impellers of

Krogh Sand Pumps

are made. This indicates their resistance to the abrasion of the grit and solids. Add to this, the fact that they cost but half as much as manganese and you begin to see why it pays to use the Krogh—the most widely used sand and tailings pump.

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They represent the best hydraulic design combined with a thoroughly practical, heavy construction that renders them the ideal prime movers for mining work.

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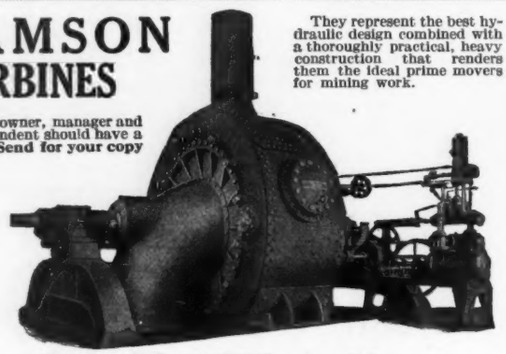

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Hand and power pumps for all uses.

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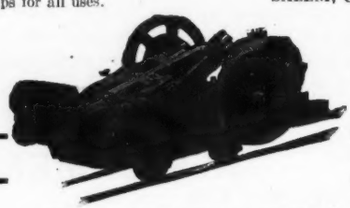

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Long life is assured by the renewable false wear plates on the bed and swing jaw. The jaw opening can be varied 2 inches without changing the toggle plates.

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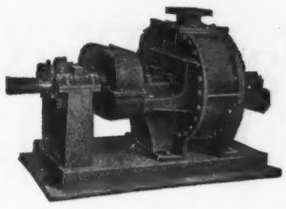

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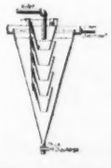

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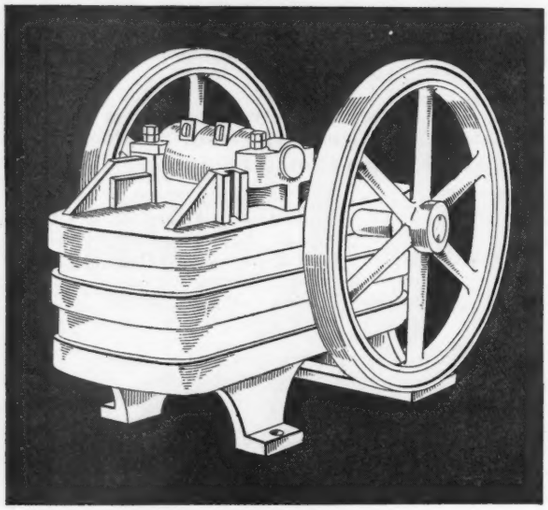

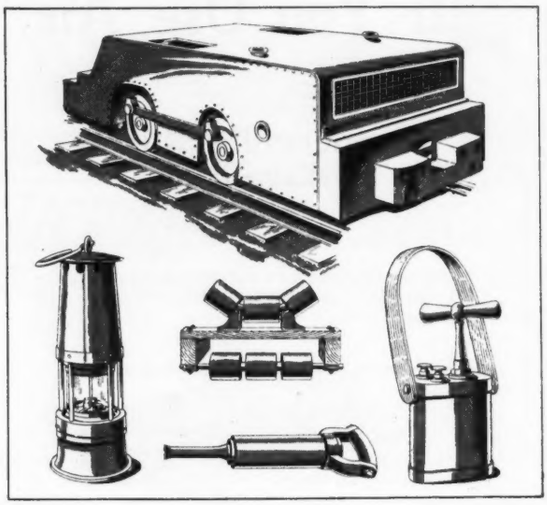

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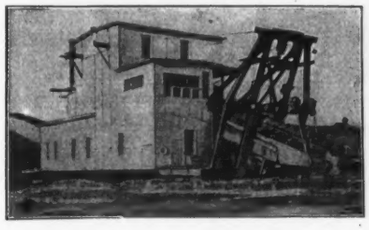

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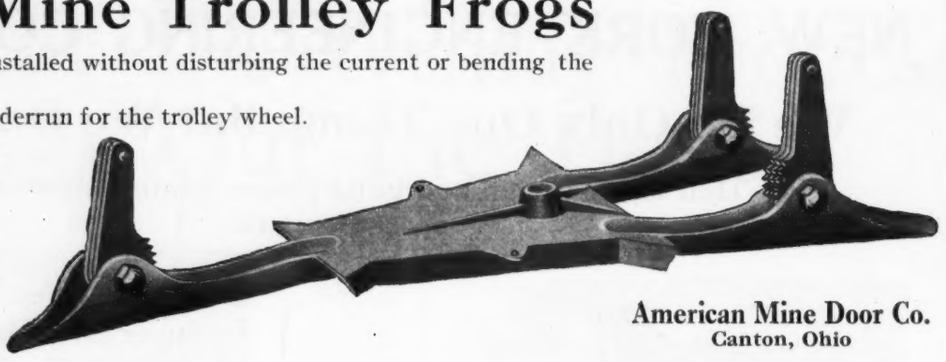

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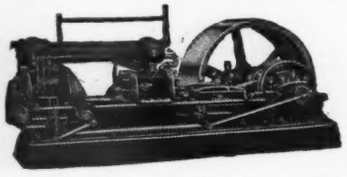

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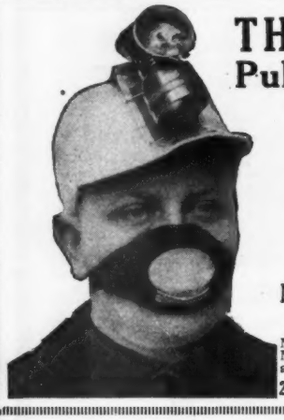

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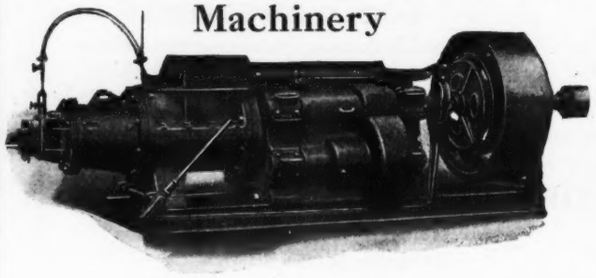

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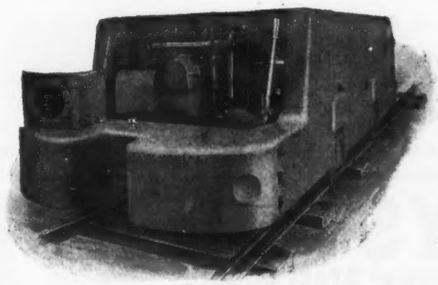

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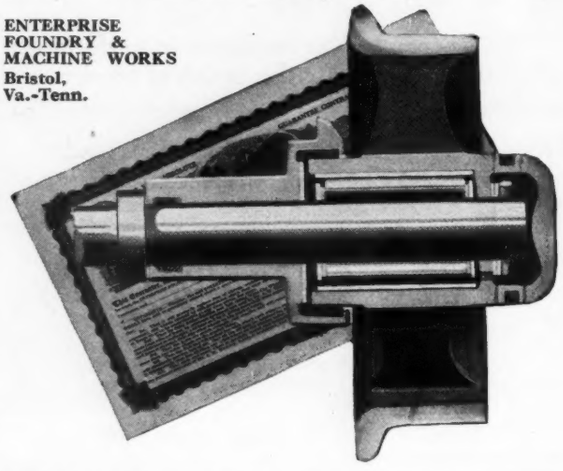

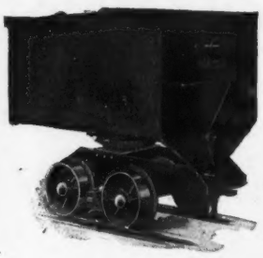

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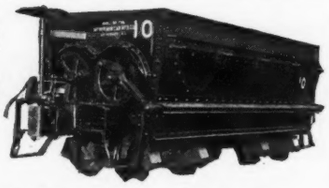

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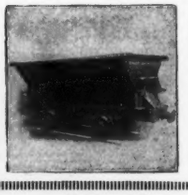

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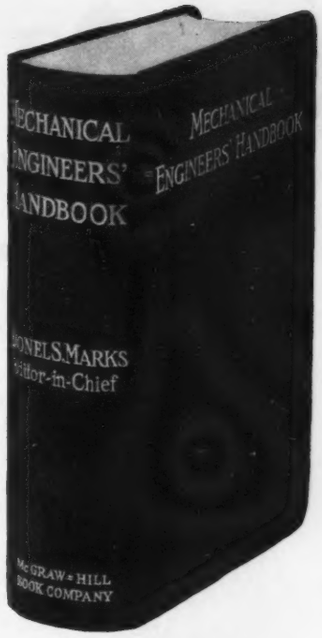

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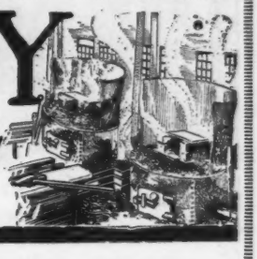

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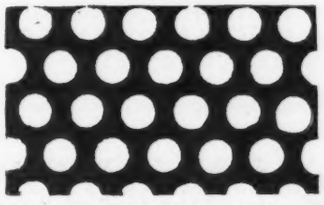

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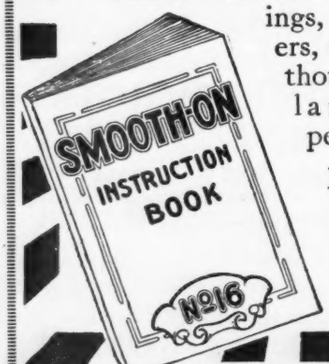

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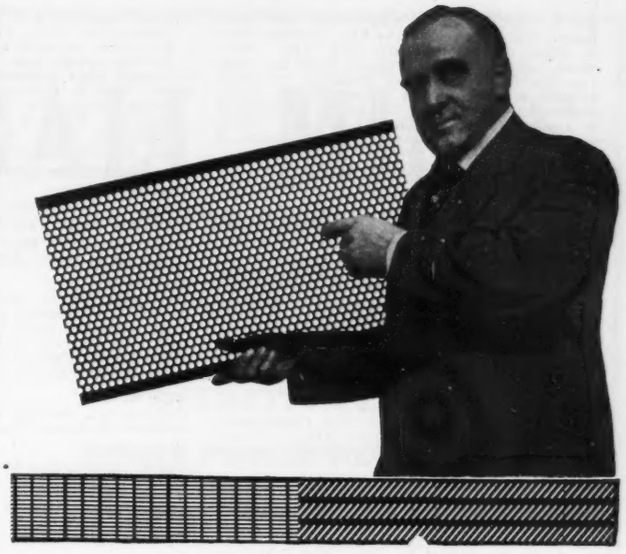

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Cores removed of any size to any depth.

Drills, Electric
Denver Rock Drill Mfg. Co., Denver, Colo.
Ingersoll-Rand Co., 11 Broadway, New York.

Drills, Hammer
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Rock Drill Co., Cleveland, Ohio.
Four sizes hand- and self-rotating sinkers, 35 to 75 lb. weight.
New valve on stopers designed to give high efficiency, speed and low repairs. Drills for stoping, sinking, drifting, block-holing and every mining requirement.
Cochise Machine Co., Los Angeles, Calif.
Denver Rock Drill Mfg. Co., Denver, Colo.
"Dreadnaught"—self rotating, valveless, hammer drill, with water device; for drifting, tunneling and all heavy drilling. Can be used unmounted with spring handle for sinking, with water device or blow valve. "Clipper"—self rotating, valveless, hammer drill, with water device or blow valve, mounted or unmounted, for drifting, sinking ,etc. "Waugh" Stoping: Valveless or valve; hammer drills; for stoping or upraising; equipped for either high or low pressure.
Hardsocg Wonder Drill Co., Ottumwa, Iowa.
All sizes and weights to 145 lb.
Have combination piston, valve and hammer. For stoping, sinking and all mining purposes.
Ingersoll-Rand Co., 11 Broadway, New York.
"Jackhamers," self-rotating hand hammer drills for every mining operation. Unmounted for down holes, mounted for light drifting, also with Leyner water device. "Leyner-Ingersoll" water drills for drifting, mining, tunneling. "Butterfly" type. "Stopehamers" "BC" and "CC" for raising, stoping, etc.
McKiernan-Terry Drill Co., 230 Bway., New York.
Sullivan Machinery Co., Chicago, Ill., U. S. A.
Whitcomb Co., Geo. D., Rochelle, Ill.

Drills, Piston
Chicago Pneumatic Tool Co., Chicago, Ill.
Cochise Machine Co., Los Angeles, Calif.
Hardsocg Wonder Drill Co., Ottumwa, Iowa.
All sizes and weights.
For use with air or steam.
Ingersoll-Rand Co., 11 Broadway, New York.
"Butterfly," "Sergeant," "Electric Air." All sizes. Also heavy quarry and submarine types.
Sullivan Machinery Co., Chicago, Ill., U. S. A.
Wood Drill Works, Paterson, N. J.
Nine sizes.

Drills, Prospecting
Ingersoll-Rand Co., 11 Broadway, New York.
New York Eng. Co., 2 Rector St., New York.
Rotation, sinking of casing, recovery of material accomplished at same time with "Empire."
Sullivan Machinery Co., Chicago, Ill., U. S. A.

Dryers, Ore
American Process Co., 68 William St., New York.
Especially designed and built for all materials.
Morse Bros. Mach. & Supply Co., Denver, Colo.
Ruggles-Coles Eng. Co., York, Penn.

Dust Hood
Multi-Metal Separating Screen Co., 253 W. 19th St., New York, N. Y.

Dust Protectors (See Respirators)

Elbows, Pipe
National Tube Co., Pittsburgh, Penn.

Electrical Supplies
Mine & Smelter Supply Co., The, Denver, Colo.

Elevators, Bucket
Robins Conveying Belt Co., New York.
Stephens-Adamson Mfg. Co., Aurora, Ill.
See advertisement on inside front cover for branch office addresses.

Employees
Business Men's Clearing House, Denver, Colo.
Supts., assayers, mill men sent all parts of world.

Engines, Gas and Gasoline
Chicago Pneumatic Tool Co., Chicago, Ill.
Morse Bros. Mach. & Supply Co., Denver, Colo.

Engines, Oil
Chicago Pneumatic Tool Co., Chicago, Ill.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
Ingersoll-Rand Co., 11 Broadway, New York.
Morse Bros. Mach. & Supply Co., Denver, Colo.
National Transit Pump & Mach. Co., Oil City, Pa.
Nordberg Mfg. Co., Milwaukee, Wis.

Engines, Steam
Morse Bros. Mach. & Supply Co., Denver, Colo.

Exhausters
Connersville Blower Co., The, Connersville, Ind.
Morse Bros. Mach. & Supply Co., Denver, Colo.

Feeders, Ore
Hardinge Conical Mill Co., 120 Broadway, N. Y.
Stephens-Adamson Mfg. Co., Aurora, Ill.
"S-A" steel apron feeder; also rotary, reciprocating, grizzly, etc.
See inside cover for branch office addresses.
James Ore Concentrator Co., Newark, N. J.

Filter Cloth, Metallic
Sweetland Filter Press Co., Singer Bldg., N. Y.

Filter Paper
Heil Chemical Co., Henry, St. Louis, Mo.

Filters
Colorado Iron Works Co., Denver, Colo.
"Portland" continuous revolving drum. For cyanide slimes, flotation concentrates, etc.
Kelly Filter Press Co., Salt Lake City, Utah.
Oliver Continuous Filter Co., San Francisco, Cal.
Sizes 5 to 200 tons per day.
Automatic. For cyanide slimes, clay, salt, bicarbonate soda, and for dewatering flotation concentrate.
Sweetland Filter Press Co., Brooklyn, N. Y.
Pressure leaf type. Convenient to operate.

Filters, Bag
Conklin, H. R., Joplin, Mo.

Fire Forcing Presses
Wood & Co., R. D., Philadelphia, Penn.

Fittings, Pipe
National Tube Co., Pittsburgh, Penn.

Flange Presses
Wood & Co., R. D., Philadelphia, Penn.

Flanges, Pipe
National Tube Co., Pittsburgh, Penn.

Flotation Oils
General Naval Stores Co., 175 Front St., N. Y.
Georgia Pine Turpentine Co., 160 Perry St., New York City.
Pensacola Tar & Turpentine Co., Gulf Point, Fla.

Flotation Cell Bottoms, Cloth
Filter Fabrics Co., Salt Lake City, Utah.

Flotation Machines
Hardinge Conical Mill Co., 120 Broadway, N. Y.

Flotation, Oil
Colorado Iron Works Co., Denver, Colo.
Oliver Continuous Filter Co., San Francisco, Cal.
Dewaterer and dryer of flotation concentrate.

Forges
Denver Fire Clay Co., Denver, Colo., U. S. A.
Oil-fired for drill steel. Send for catalog.
Ingersoll-Rand Co., 11 Broadway, New York.
Monarch Eng. & Mfg. Co., Baltimore, Md.

Framers, Timber
Denver Engineering Works Co., Denver, Colo.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.

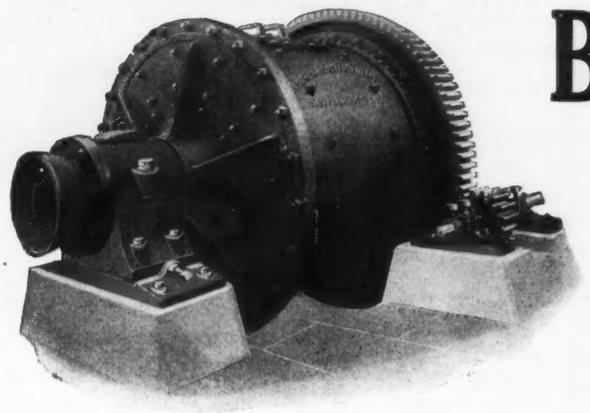
Frogs and Switches
American Mine Door Co., Canton, Ohio.
Cincinnati Frog & Switch Co., Cincinnati, Ohio.

Furnaces, Assay
Braun Corporation, The, Los Angeles, Calif.
Braun-Knecht-Heimann Co., San Francisco, Calif.
Denver Fire Clay Co., Denver, Colo., U. S. A.
"Case" patent. One-, two- or three-muffle design unit system, low pressure air.
Mine & Smelter Supply Co., The, Salt Lake City, Utah. Branches: Denver, El Paso, New York.

Furnaces, Bullion Melting
Braun Corporation, The, Los Angeles, Calif.
Braun-Knecht-Heimann Co., San Francisco, Cal.
Denver Fire Clay Co., Denver, Colo., U. S. A.
"Case" patent. Oil-fired, low-pressure air, high temperatures quickly attained.
Send for catalog.
Monarch Engineering & Mfg. Co., Baltimore, Md.

Furnaces, Electric
General Electric Co., Schenectady, N. Y.

Furnaces, Mechanical Roasting
Dwight & Lloyd Sintering Co., Inc., N. Y. City.
General Chemical Co., Herreshoff Furnace Dept. B, 25 Broad St., New York, N. Y.
Ten sizes, 5 to 7 hearths, 381 to 1,925 sq.ft. hearth area.
Cylindrical steel shell contains vertically superimposed hearth. By rabble arms operated from central vertical shaft, roasting ore travels from center of top hearth, down through lower ones, discharging from rim of lowest. Heated air for combustion travels upward.
Morse Bros. Mach. & Supply Co., Denver, Colo.
Wedge Mechanical Furnace Co., 115 Chestnut St., Philadelphia.



BALL MILLS

RAPID DISCHARGE

DUTY AND EFFICIENCY VERY HIGH

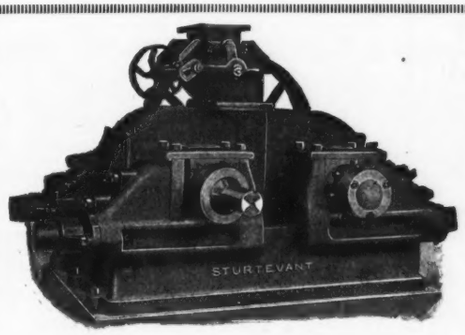
COST OF INSTALLATION AND OPERATION LOW

SMALL POWER REQUIRED

Designed and Built to Fulfill the Demands of Continuous Hard Service.
"HENDY" BALL MILLS are incomparable as intermediate grinders in sliming for cyanide treatment.

ALSO FITTED WITH NEW AMALGAMATING DEVICE
For Free Milling Gold Ores.

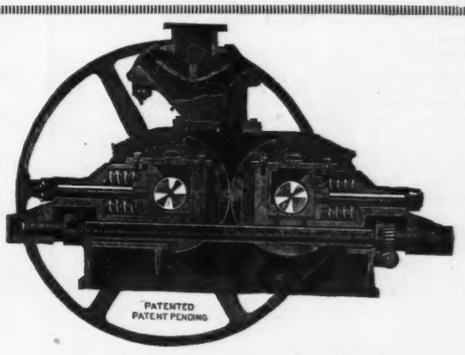
MANUFACTURED BY
JOSHUA HENDY IRON WORKS
SAN FRANCISCO, CAL.



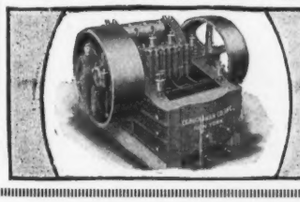
Sturtevant
Balanced Crushing Rolls

Rigid to Ore (properly fed). Quick relief to iron or other uncrushable substances.
Big shafts, ample bearings, heavy construction.
Side and end adjustments. Everything strictly high grade. Built in 7 sizes.

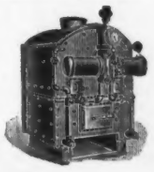
Send for Catalog No. 65.



Sturtevant Mill Co. - - - - **Boston, Mass.**
New York Chicago Denver Pittsburgh London



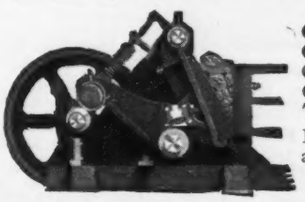
BUCHANAN All-Steel **CRUSHERS**
Crushing Rolls
Magnetic Separators
Crushing Plants complete in all details from 100 to 5,000 tons daily capacity.
C. G. BUCHANAN CO., INC.
Main Office: 90 West St., New York,
Branch: 1218 Chestnut St., Philadelphia, Pa.



The ALMY Sectional Boiler
Can be transported by burros. Is a rapid steam generator; occupies small space; non-explosive and delivers the steam *dry*. Catalog?
Almy Water Tube Boiler Company
Providence, R. I., U. S. A.

FOR FINE CRUSHING

at ONE OPERATION the crusher illustrated reduced feldspar granite from one man stone to the following sizes:



ON ¼-in. mesh.... 3.2%
ON No. 10 mesh...31.9%
ON No. 20 mesh...31.9%
ON No. 40 mesh...14.1%
Through No. 40 " 18.8%

It will save one set of rolls and in some cases two sets

Send for Circular.

Universal Road Machinery Co.
Kingston, N. Y.

Varying stock sizes, number of hearths and hearth areas.
Hearths placed one above the other vertically all enclosed in suitable shell. Vertical shaft revolves in center, raking ore on hearths, by rabbles and teeth attached to arms. Ore travels through furnace from top to bottom. To correct inequalities in the supply of heat, combustion gases pass through heating chambers between hearths, as well as to hearths themselves. External fireboxes communicate with the heating chambers through flues. Central shaft designed to be accessible.
Send for catalog.
Zinc Concentrating Co., 60 Congress St., Boston, Mass.
Etherington-Singer roaster used in connection with Campbell magnetic separating process. Non-oxidizing. Oil fuel. Roasts in comparatively short time.

Furnaces, Smelting
Colorado Iron Works Co., Denver, Colo.
Morse Bros. Mach. & Supply Co., Denver, Colo.
Traylor Eng. & Mfg. Co., Allentown, Penn.

Fuses, Electric
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.
Wellman-Seaver-Morgan Co., Cleveland, Ohio.
Wood & Co., R. D., Philadelphia, Penn.

Gas Producers
Wood & Co., R. D., Philadelphia, Penn.

Gas Purifiers
Wood & Co., R. D., Philadelphia, Penn.

Gears
Philadelphia Gear Works, 1120 Vine St., Philadelphia. Cable Address: "Philagear."
All sizes.
All descriptions gear cutting and wheels.

Gears, Bevel
Philadelphia Gear Works, 1120 Vine St., Philadelphia. Cable Address: "Philagear."

Gears, Double Helical
Caldwell & Sons Co., H. W., 17th St. and Webster Ave., Chicago.
Falk Co., The, Milwaukee, Wis.
Any face to 42 in.; diameter to 12 ft.
Staggered herringbone teeth with continuous tooth engagement. Machine-cut from solid blanks.

Gears, Rawhide
Philadelphia Gear Works, 1120 Vine St., Philadelphia. Cable Address: "Philagear."

Generators, Electric
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Graphite
Dixon Crucible Co., Joseph, Jersey City, N. J.

Grease
Dixon Crucible Co., Joseph, Jersey City, N. J.

Grease Cups
Lunkenheimer Co., The, Cincinnati, Ohio.

Grinders, Ore
Braun Corporation, The, Los Angeles, Calif.
Braun-Knecht-Heimann Co., San Francisco, Cal.
Laboratory machines for ore, coke and coal.
Freese Co., E. M., Galion, Ohio.
Hardinge Conical Mill Co., 120 Broadway, N. Y.
Sturtevant Mill Co., Boston, Mass.

Grinders, Sample
Denver Engineering Works Co., Denver, Colo.
Sturtevant Mill Co., Boston, Mass.

Hoists, Electric
Denver Engineering Works Co., Denver, Colo.
Flory Mfg. Co., S. Bangor, Penn.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
Lidgerwood Mfg. Co., 96 Liberty St., New York. Branches: Philadelphia, Pittsburgh, Chicago, Seattle.
All sizes.
Nordberg Mfg. Co., Milwaukee, Wis.
Vulcan Iron Works, Wilkes-Barre, Penn.

Hoists, Portable
Chicago Pneumatic Tool Co., Chicago, Ill.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
"Little Tugger"—for drill column, bar or timber mounting. It operates on air.
Mine & Smelter Supply Co., The, Denver, Colo.
"Holman" stretcher-bar hoist, air or steam.

Hoist Recorder
Johnson, J. M. & O. R., Ishpeming, Mich.
Records automatically and graphically on chart in engine room, position of cage or skip at any minute of day.

Hoists, Steam
Flory Mfg. Co., S., Bangor, Penn.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
Lidgerwood Mfg. Co., 96 Liberty St., New York.
Sizes up to 1,000 hp.
Nordberg Mfg. Co., Milwaukee, Wis.
Sullivan Machinery Co., Chicago, Ill., U. S. A.
First motion Corliss and geared slide valve with automatic cut-off.
Vulcan Iron Works, Wilkes-Barre, Penn.

Hose, Air
Cleveland Rock Drill Co., Cleveland, Ohio.
All sizes.
Plain and wire wound in stock.
Denver Rock Drill Mfg. Co., Denver, Colo
Wire wound, blue jacket and red jacket drill hose.
Goodrich Co., The B. F., Akron, Ohio.
Sizes ½" up.
Wrapped duck and braided fabric types. See "Commander." Resists injury through twists.
Hardsocg Wonder Drill Co., Ottumwa, Iowa.
½", ¾", 1", plain and armored. Fitted with nipples and patent coupler.
Mine & Smelter Supply Co., The, Denver, Colo.

Hydraulic Accumulators
Wood & Co., R. D., Philadelphia, Penn.

Hydraulic Giants
Pelton Water Wheel Co., San Francisco. New York.

Idlers, Conveyor
Conveying Weigher Co., The, New York City.

Instruments, Surveying
Ainsworth & Sons, Wm., Denver, Colo.
Alteneder & Sons, T., Philadelphia, Penn.
Berger & Sons Co., C. L., Boston, Mass.
Buff & Buff Mfg. Co., Boston, Mass.
Transits, levels, current meters.
Lietz Co., The A., San Francisco, Calif.

Insulating Materials, Electric
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Jackets, Water
Traylor Eng. & Mfg. Co., Allentown, Penn.

Jigs
American Zinc Ore Separating Co., 1218 Foster Bldg., Denver, Colo.
Two sizes, 24 and 36 in. Capacities to 15 tons per 24 hr.
Operates with air instead of water. Air, through a rotary valve delivers rapid succession of air impulses beneath screen, stratifying concentrates on screen. Feed and discharge automatic.
Denver Engineering Works Co., Denver, Colo.
Richards pulsator jigs and riffles.
James Ore Concentrator Co., Newark, N. J.
Worthington Pump & Machinery Corporation, 115 Broadway, New York.

Kilns, Rotary
Worthington Pump & Machinery Corporation 115 Broadway, New York.

THIS is a live list of reputable concerns that sell machinery and supplies for metal mines, mills and smelters. Its use will save your time.

Laboratory Machinery
Braun Corporation, The, Los Angeles, Calif.
Braun-Knecht-Heimann Co., San Francisco, Cal.
Denver Fire Clay Co., Denver, Colo.
Mine & Smelter Supply Co., The, Denver, Colo.
Sturtevant Mill Co., Boston, Mass.

Laboratory Supplies
Heil Chemical Co., Henry, St. Louis, Mo.

Lamps, Acetylene
Milburn Co., The Alexander, Baltimore, Md.
Simmons Co., John, 34 35th St., Brooklyn, N. Y.
From 3- to 12-hr. capacity.
Baldwin and Zar. Cap and hand styles.
Wolf Safety Lamp Co., 74 Washington St., N. Y.

Lamps, Electric
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Lightning Arresters
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Line Material, Overhead
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Linings, Ball Mill
Hardinge Conical Mill Co., 120 Broadway, N. Y.

Locomotives, Compressed Air
Porter Co., H. K., 410 Wood St., Pittsburgh, Penn.

Locomotives, Electric
General Electric Co., Schenectady, N. Y.
Jeffrey Mfg. Co., The, 974 N. 4th St., Columbus, O.
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Locomotives, Electric Storage Battery
Atlas Car & Mfg. Co., Cleveland, Ohio.
General Electric Co., Schenectady, N. Y.
Jeffrey Mfg. Co., The, 974 N. 4th St., Columbus, O.
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Locomotives, Gasoline
Vulcan Iron Works, Wilkes-Barre, Penn.
Whitcomb Co., Geo. D., Rochelle, Ill.

Locomotives, Industrial
American Locomotive Co., 30 Church St., N. Y.

Locomotives, Mine
American Locomotive Co., 30 Church St., N. Y.

Locomotive Parts
American Locomotive Co., 30 Church St., N. Y.

Locomotives, Steam
American Locomotive Co., 30 Church St., N. Y.
Porter Co., H. K., 410 Wood St., Pittsburgh, Penn.
Branch: 30 Church St., New York.
Vulcan Iron Works, Wilkes-Barre, Penn.

Lubricants
Dixon Crucible Co., Joseph, Jersey City, N. J.

Lubricators
Whitcomb Co., Geo. D., Rochelle, Ill.

Magnetic Pulleys
Dings Magnetic Separator Co., 673 Smith St., Milwaukee, Wis.
Magnetic pulleys in all sizes. When used as head pulley in belt conveyor, it converts latter into magnetic separator. Will save machinery by throwing out unbreakable iron substances, such as hammer heads, etc.

Meters, Electric Current
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Metals and Alloys
Primos Chemical Co., Primos, Del. Co., Pa. Cable: "Briquette, Phila." Branches: Vanadium and Lakewood, Colo.
Agents: Allan S. Davison & Co., Pittsburgh, Pa.

Metals, Noncorrosive
International Nickel Co., The, 43 Exchange Place, New York.
"Monel" metal. Tough acid-resisting alloy. Rods, flats, castings, sheets, strips and wire.

Metals, Perforated
Erdle Perforating Co., Rochester, N. Y.
Harrington & King Perforating Co., The, 620 N. Union Ave., Chicago, Ill. Branch: 114 Liberty St., New York.
All sizes and shapes of perforations; all kinds and thicknesses of metals.
Screens for trommels, stamp mills, jigs, etc.
Hendrick Mfg. Co., Carbondale, Penn.

Mills, Ball, Tube and Pebble
Colorado Iron Works Co., Denver, Colo.
Denver Engineering Works Co., Denver, Colo.
Hardinge Conical Mill Co., 120 Broadway, New York. Cable Address: Halharding, N. Y. Branches: London, Salisbury House.
Sizes made, 3', 4½', 6', 8', 10'. Both ball and pebble mills. Capacities, 10 tons per day up to 800 tons per day.
Slow speed revolving mills for intermediate and fine grinding, employing a multitude of grinding media, either balls or pebbles, embodying the Hardinge Patent Conical principle, the cones acting as a classifier both of energy expended and materials produced, to give a uniform product, due to this classifying action without the use of screens, grizzlies, grates or other mechanical attachments.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
Mine & Smelter Supply Co., The, Denver, Colo.
"Marcy" ball mills.
Traylor Eng. & Mfg. Co., Allentown, Penn.
All sizes and capacities.
Williamson, F. O., Old Colony Bldg., Chicago, Ill.
Worthington Pump & Machinery Corporation, 115 Broadway, New York.

Mills, Chilean
Lane Mill & Machinery Co., Los Angeles, Calif.
Cable: "Lanemill."
Sizes: 5-, 7- and 10-ft. Capacities: 10, 20 and 40 tons per 24 hr.
"Slow-speed" Chilean mills. 20- and 40-ton mills can be sectionalized for transportation on pack animals.

Mills, Stamp
Colorado Iron Works Co., Denver, Colo.
Denver Engineering Works Co., Denver, Colo.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
Hendy Iron Works, Joshua, San Francisco, Calif.
Traylor Eng. & Mfg. Co., Allentown, Penn.
Worthington Pump & Machinery Corporation, 115 Broadway, New York.

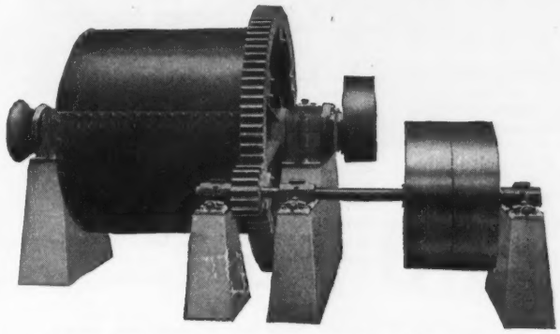
Mining Cap Protectors
Miller Mfg. Co., 331 First National Bank Bldg., El Paso, Tex., or Hercules Powder Co., Wilmington.
For waterproofing mine caps. A thin, pure gum tubing that waterproofs joint and firmly fastens cap and fuse without crimping.

Mine Doors, Automatic
American Mine Door Co., Canton, Ohio.

Minerals and Ores, Rare
Foote Mineral Co., 101 N. 19th St., Phila., Pa.
Specialists in unusual ores.
Ward's Natural Science Estab., Rochester, N. Y.

Mixers, Concrete
Smith Co., The T. L., 1143 32nd St., Milwaukee.

The Standard Ball Mill



The simplest, strongest and most durable mill on the market.

NO inside screens, lifting devices or features to give trouble. Lining is self locking, no bolts through the shell, maximum wear of lining. Lining made of special manganese, the most durable made. Scoop feed with renewable steel wearing lips. Trunnions equipped with spiral feed and reverse spiral discharge. Made in all sizes. The following in stock for immediate shipment.

5x4 Ball charge, 6,000 lbs. h.p. 40, capacity crusher product to 12 mesh, 10 tons per hour. Weight 13,500 lbs.

4x3 Ball charge 2,300 lbs. h.p. 15, capacity crusher product to 12 mesh, 3 tons per hour. Weight 8,750 lbs.

Laboratory and sample mill either ball or pebble, 250 lbs. to charge. Kept in stock.

The Morse Bros. Machinery & Supply Co.
Denver - - - - - - Colo.

The Lane Slow Speed Chilean Mill

uses less power than a stamp mill, costs less to keep in repair, and does better work. It is capable of delivering a product to suit almost any ore or any process. Our Catalog No. 7 tells all about the mill and its work. Send for it. It will interest you.

Lane Mill & Machinery Company
422-423 Wesley Roberts Building **Los Angeles, California**

MAXECON MILL

A Grinder for all kinds of ores

Especially adapted for grinding ores for CYANIDING

KENT MILL CO.,
New York, Borough of Brooklyn, 10 Rapelyea Street
LONDON, W. C.—31 High Holborn. BERLIN—Charlottenburg 5, Windschied Strasse 31.

BACON'S ORE & ROCK CRUSHING ROLLS
SEND FOR CATALOGUE
EARLE C. BACON, ENGINEER, HAVEMEYER BLDG NEW YORK

ATKINS, KROLL & CO. SAN FRANCISCO
Import Merchants
DANISH FLINT PEBBLES, SILEX LINING, CYANIDE QUICKSILVER, MINING CANDLES, FIREBRICK, BORTS AND CARBONS, BLACKSMITH COAL, COKE IMPORTED FUSE, SHEELITE CONCENTRATES 70%. SUPERIOR QUALITY ZINC DUST.
Stocks Carried
Buyers of Quicksilver and Platinum, also Ores of Antimony, Bismuth, Molybdenum, Tungsten, Vanadium, Zinc, etc.

Braun K. & K. Laboratory Flotation Machine

Ready for Work

A Miniature Machine suitable for laboratory tests, built similar to the Standard Size

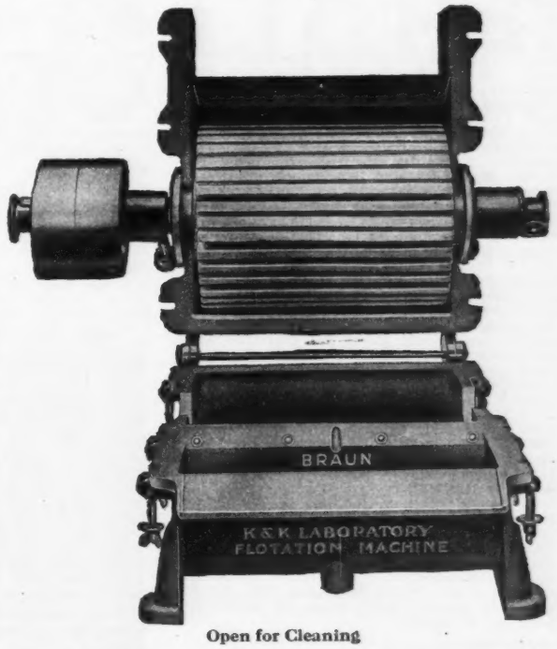
K. & K. Flotation Machines

now used by many large metallurgical plants practicing flotation.

This machine produces every effect essential to determine to what extent an ore will lend itself to flotation.

The elimination of violent agitation adapts it to **all classes of ores,** including **carbonates,** and permits **selective flotation tests.**

The top is hinged allowing ready access for thorough cleaning.



Open for Cleaning

Ask for your copy of Bulletin S120.

BRAUN-KNECHT-HEIMANN-CO. **San Francisco, U. S. A.**

THE BRAUN CORPORATION **Los Angeles, U. S. A.**

Hand batch mixer for mines, $120. Power mixers, all sizes, any equipment.

Molybdenum Ore, Buyers of

Primos Chemical Co., Primos, Del. Co., Pa. Cable: "Briquette, Phila." Branches: Vanadium and Lakewood, Colo.
Agents: Allen S. Davison & Co., Pittsburgh, Pa.

Motors

General Electric Co., Schenectady, N. Y.
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Motor Control

Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.
For all types and capacities of motors.

Motor Generator Sets

General Electric Co., Schenectady, N. Y.
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Netting, Wire

Ludlow-Saylor Wire Co., St. Louis, Mo.
"Hex" poultry netting. Stack netting for locomotives.
Catalog No. 45.

Nickel

International Nickel Co., The, 43 Exchange Place, New York.

Oiled Clothing

Goodrich Co., The B. F., Akron, Ohio.
So'westers, jackets, apron pants. Rubber goods for abrasive wear.

Oils, Flotation (See "Flotation Oils")

Ore, Buyers and Sellers of

American Metal Co., New York City.
Agents: Henry R. Merton & Co., Ltd., London; Metallgesellschaft, Frankfort-on-the-Main; Compania des Minerales y Metales, Mexico City and Monterey; Ore Trading Co., Ltd., Santiago, Chile.
American Smelting & Refining Co., 120 Broadway, New York.
Agents: Paul Koning, Berlin, Germany; Kleinwort, Sons & Co., London, England; W. A. Price and Geo. J. Ewart, City of Mexico; F. D. Aller, Antofagasta, Chile.
American Zinc, Lead & Smelting Co., 55 Congress St., Boston, Mass.
American Zinc & Chemical Co., Langeloth, Penn.
Arizona Copper Co., Clifton, Ariz.
Arkansas Zinc & Smelting Corp., 42 Broadway, New York.
Balbach Smelting & Refining Co., Newark, N. J.
Bartlesville Zinc Co., 52 Broadway, New York.
Beer, Sondheimer & Co., 61 Broadway, New York. Branch: 1101 Newhouse Bldg., Salt Lake City, Utah.
See advertisement.
Blackwell, Sons & Co., Ltd., Geo. G., The Albany, Liverpool, England.
Consolidated Mining & Smelting Co. of Canada, Ltd., The, Trail, British Columbia.
Ducktown Sulphur, Copper & Iron Co., Ltd., Isabella, Tenn.
Edgar Zinc Co., Boatmen's Bank Bldg., St. Louis, Mo. Western Ore Purchasing Agent: David Taylor, Boston Bldg., Salt Lake City, Utah.
Foote Mineral Co., 107 N. 19th St., Phila., Pa.
Grasselli Chemical Co., The, Cleveland, Ohio.
Granby Mining & Smelting Co., Suite 1710, Third National Bank Bldg., St. Louis, Mo. 120 Broadway, New York, N. Y.
Hardy, Charles, 50 Church St., New York.
Hegeler Zinc Co., The, Danville, Ill.
Illinois Zinc Co., Peru, Ill.
International Smelting Co., 42 Broadway, New York. Ore Purchasing Department, 621 Kearns Bldg., Salt Lake City, Utah. Smelting Works, International, Utah, and Miami, Ariz. Refineries, Raritan Copper Wks., Perth Amboy, N. J.; Internat. Lead Refining Co., E. Chicago, Ind.
Irvington Smelting & Refining Works, Irvington, N. J. Branch Office: New York.
Leavitt & Co., C. W., 30 Church St., New York.
Matthiessen & Hegeler Zinc Co., La Salle, Ill.
Nichols Copper Co., 25 Broad St., New York.
See advertisement.
Ozark Mining Co., 601 Canal Rd., Cleveland, Ohio.
Pass & Son, Ltd., Capper, Bristol, England.
Pennsylvania Smelting Co., Pittsburgh, Penn.
Phelps, Dodge & Co., New York City.
Philipp Bros., 29 Broadway, New York.
United Metals Selling Co., 42 Broadway, New York. European Agents: C. S. Henry & Co., Ltd., 12 Leadenhall St., London, E. C.; United Metals Selling Co., G. M. B. H., Unter den Linden 56, Berlin, Germany.
See advertisement.
United States Smelting, Refining & Mining Co., 55 Congress St., Boston, U. S. A. Works: Midvale, Utah; Needles, Calif.; Gold Road, Ariz.; Kennett, Calif.; Chrome, N. J.; Grasselli, Ind.; Pachuca and Real del Monte, Mexico.
See advertisement.
Vogelstein & Co., L., 42 Broadway, New York.
European Agents: Aron Hirsch & Sohn, Halberstadt, Germany.

Ores, Samplers of

Beach & Co., 204 Boston Bldg., Denver, Colo.
Supervise weighing and sampling at smelters.
Ledoux & Co., Inc., 99 John St., New York.

Oxy-Acetylene, Welding and Cutting Apparatus

Milburn Co., The Alexander, Baltimore, Md.
"Milburn" oxy-acetylene apparatus.

Packing

Goodrich Co., The B. F., Akron, Ohio.
Sheet, tubular, spiral, square, rubber and duck.
Jenkins Bros., 80 White St., New York.

Paint, Preservative

Dixon Crucible Co., Joseph, Jersey City, N. J.

Pebbles, Grinding

Atkins, Kroll & Co., San Francisco.
Encinitas Cash Store, Encinitas, Calif.

Pipe, Cast Iron

Wood & Co., R. D., Philadelphia, Penn.
All kinds and sizes, 1 to 72 in.

Pipe, Riveted Steel

Weigele Riveted Steel Pipe Works, Denver, Colo.

Pipe, Spiral Riveted

Abendroth & Root Mfg. Co., 45 Bway., New York.

Pipe, Steel

National Tube Co., Pittsburgh, Penn.

Pipe, Wood

National Tank & Pipe Co., Portland, Oregon.
Pacific Tank & Pipe Co., San Francisco, Calif.
Redwood Mfrs. Co., San Francisco, Calif.
Wyckoff & Son Co., A., Elmira, N. Y.

Platinum

Baker & Co., Inc., Newark, N. J. Branch: New York.
Hammered ware of all sizes and shapes.

Preservative, Metal

Highland Chemical Products Co., Connellsville, Penn.

Presses, Filter

Kelly Filter Press Co., Salt Lake City, Utah.
Shriver & Co., T., 826 Hamilton St., Harrison, N. J.
Sweetland Filter Press Co., Brooklyn, N. Y.
Worthington Pump & Machinery Corporation, 115 Broadway, New York.

Presses, Hydraulic

Wood & Co., R. D., Philadelphia, Penn.

Publishers, Technical Book

McGraw-Hill Book Co., Inc., 239 West 39th St., New York. Branches: London and Berlin.

Pulverizers, Coal

Hardinge Conical Mill Co., 120 Broadway, N. Y.

Pulverizers, Ore

Braun Corporation, The, Los Angeles, Calif.
Laboratory machines for all purposes and prospecting.
Braun-Knecht-Heimann Co., San Francisco, Cal.
Hardinge Conical Mill Co., 120 Broadway, N. Y.
Mine & Smelter Supply Co., The, Denver, Colo.
Sturtevant Mill Co., Boston, Mass.

Pumps, Acid

Byron Jackson Iron Works, Inc., San Francisco.

Pumps, Boiler Feed

Cameron Pump Wks., 11 B'way., New York.
Deming Co., The, Salem, Ohio.

Pumps, Centrifugal

Byron Jackson Iron Works, Inc., San Francisco.
Cameron Pump Wks., 11 B'way., New York.
De Laval Steam Turbine Co., Trenton, N. J.
Deming Co., The, Salem, Ohio.
Krogh Pump Mfg. Co., San Francisco, Calif.
Lane & Bowler Corp., Los Angeles, Calif.
Pelton Water Wheel Co., San Francisco. New York.
Wood & Co., R. D., Philadelphia, Penn.

Pumps, Deep Well

Alberger Pump & Condenser Co., New York City.
Byron Jackson Iron Works, Inc., San Francisco.
Cameron Pump Works, 11 Broadway, New York.
Sheet, rod, wick, rope and stem packing.
Deming Co., The, Salem, Ohio.
Krogh Pump Mfg. Co., San Francisco, Calif.

Pumps, Electric

Byron Jackson Iron Works, Inc., San Francisco.
Cameron Pump Wks., 11 B'way., New York.
Deming Co., The, Salem, Ohio.
Krogh Pump Mfg. Co., San Francisco, Calif.
Roots Co., P. H. & F. M., Connersville, Ind.

Pumps, Mine

Alberger Pump & Condenser Co., New York.
Byron Jackson Iron Works, Inc., San Francisco.
Cameron Pump Works, 11 Broadway, New York.
Twelve sizes, low head, to 7,500 gal. per min.
Deming Co., The, Salem, Ohio.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
Krogh Pump Mfg. Co., San Francisco, Calif.
Layne & Bowler Corp., Los Angeles, Calif.
Morris Machine Works, Baldwinsville, N. Y.
Wood & Co., R. D., Philadelphia, Penn.

Pumps, Mill

Cameron Pump Works, 11 Broadway, New York.
Deming Co., The, Salem, Ohio.
Frenier & Son, J. H., Rutland, Vt., U. S. A.
Krogh Pump Mfg. Co., San Francisco, Calif.
Layne & Bowler Corp., Los Angeles, Calif.
Roots Co., P. H. & F. M., Connersville, Ind.
Traylor Eng. & Mfg. Co., Allentown, Penn.
Worthington Pump & Machinery Corporation, 115 Broadway, New York.

Pumps, Pneumatic Air Lift

Sullivan Machinery Co., Chicago, Ill., U. S. A.

Pumps, Power Plant

Alberger Pump & Condenser Co., New York.
Cameron Pump Works, 11 Broadway, New York.
Deming Co., The, Salem, Ohio.
National Transit Pump & Mach. Co., Oil City, Pa.
Roots Co., P. H. & F. M., Connersville, Ind.

Pumps, Sand, Slime and Tailings

Byron Jackson Iron Works, Inc., San Francisco.
New type, with closed runner. Correctly designed liner and mechanical thrust bearing.
Frenier & Son, J. H., Rutland, Vt.
Krogh Pump Mfg. Co., San Francisco, Calif.
All sizes regularly 2" to 8". Low-cost white iron liners and open-type impeller.
Layne & Bowler Corp., Los Angeles, Calif.

Pumps, Sinking

Byron Jackson Iron Works, Inc., San Francisco
Cameron Pump Wks., 11 B'way., New York.
Deming Co., The, Salem, Ohio.
Krogh Pump Mfg. Co., San Francisco, Calif.
Layne & Bowler Corp., Los Angeles, Calif.

Pumps, Vacuum

Alberger Pump & Condenser Co., New York City.
Cameron Pump Works, 11 Broadway, New York.
Ingersoll-Rand Co., 11 Broadway, New York.
Roots Co., P. H. & F. M., Connersville, Ind.

Pumps, Vacuum, Steam

Emerson Steam Pump Co., The, Alexandria, Va.

Punches, Hydraulic

Wood & Co., R. D., Philadelphia, Penn.

Pyrometers, Indicating and Recording

Thwing Inst. Co., 445 N. 5th St., Phila., Pa.

Quicksilver

Beer, Sondheimer & Co., Inc., 61 Broadway, N. Y.

Radium Ore

Willmarth, O. Barlow, Montrose, Idaho Springs, Colo.

Rails, Steel

Sweet's Steel Co., Williamsport, Penn.

Refractories

Harbison-Walker Refractories Co., Pittsburgh, Pa.

Respirators

Goodrich Co., The B. F., Akron, Ohio.
White rubber; complete with elastic head straps, sponge and cloth filter disc.
Multi-Metal Separating Screen Co., 253 W. 19th St., New York.
Small and light, 75 cents.

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Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Riddles, Wire

Ludlow-Saylor Wire Co., St. Louis, Mo.
Sizes, ¾- to 1½-in. mesh.
Catalog No. 45.

Riveters, Hydraulic

Wood & Co., R. D., Philadelphia, Penn.

Rolls, Crushing (See "Crushers")

Rope, Wire

American Steel & Wire Co., Chicago. Branches: New York, Worcester, Cleveland, Pittsburgh, Denver; Pacific Coast, U. S. Steel Products Co., San Francisco, Los Angeles, Portland, Seattle.
Broderick & Bascom Rope Co., 805-807-809 N. Main St., St. Louis, Mo. Cable: "Broderick." Branches: Factories, St. Louis and Seattle. Branch Offices: New York City and Seattle. Agents: San Francisco, Pittsburgh, Chicago, New Orleans, Boston, Jacksonville, Fla.; Duluth, San Antonio, Spokane, Portland, Ore.; Denver, Houston, Tex.
Leschen & Sons Rope Co., A., St. Louis, U. S. A. N. Y., Chi., Denver, Salt Lake, San Francisco.
Roebling's Sons Co., John A., Trenton, N. J.
Waterbury Co., 63 Park Row, New York. Branches: Chi., San Francisco, New Orleans, Boston. Agent: Powell & Eliet Co., Dallas, Tex.

Rules, Measuring

Lufkin Rule Co., Saginaw. Mich.

Samplers, Ore

Braun Corporation, The, Los Angeles, Calif.
For laboratory work.
Braun-Knecht-Heimann Co., San Francisco, Cal.
Denver Engineering Works Co., Denver, Colo.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
Mine & Smelter Supply Co., The, Denver, Colo.

Scales, Conveyor

Conveying Weigher Co., The, New York City.

Screens

Colorado Iron Works Co., Denver, Colo.
James Ore Concentrator Co., Newark, N. J.

Screens, Incline Vibratory

Sturtevant Mill Co., Boston, Mass.

Screens, Perforated Metal

Chicago Perforating Co., Rochester, N. Y.
Erdle Perforating Co., Rochester, N. Y.
Harrington & King Perforating Co., The, 620 N. Union Ave., Chicago, Ill. Branch: 114 Liberty St., New York.
All sizes and shapes of perforations; all kinds and thicknesses of metals.
Screens for trommels, stamp mills, jigs, etc.
Hendrick Mfg. Co., Carbondale, Penn.

Screens, Revolving

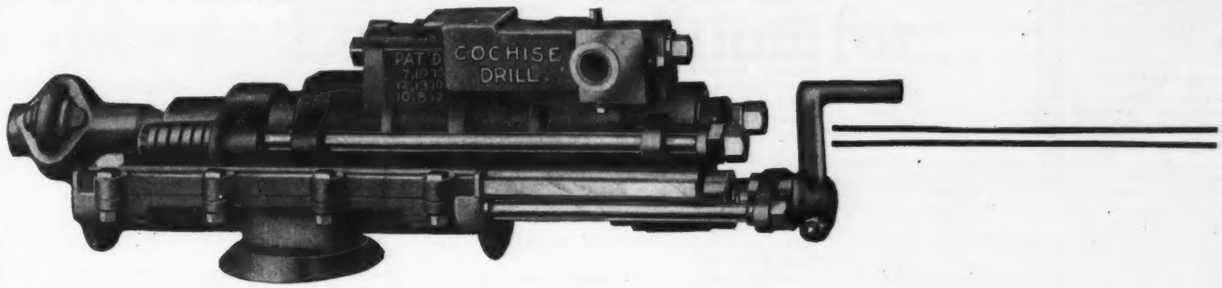
Harrington & King Perforating Co., The, 620 N. Union Ave., Chicago, Ill. Branch: 114 Liberty St., New York.
All kinds perforated metal for revolving screws.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
Stephens-Adamson Mfg. Co., Aurora, Ill.
See advertisement on inside front cover for branch office addresses.
Traylor Eng. & Mfg. Co., Allentown, Penn.

Screens, Rolled Slot

Ludlow-Saylor Wire Co., St. Louis, Mo.
"Rek-tang" for rolled slot screens in steel brass, copper or bronze.
Catalog No. 45 and special "Rek-tang" catalog.

Screens, Wire

Ludlow-Saylor Wire Co., St. Louis, Mo.
All gages and meshes.
"Perfect" double-crimped. Every wire crimped around every other. "Rek-tang," rolled slot,



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They have never been surpassed in capacity. Only one man is required to operate them.

Their air consumption is remarkably low due to the rapid cut-off secured by the Cochise valve. There can be no wire drawing or fluttering.

Used by the leading mines. Endorsed by superintendents for economy, convenience and small upkeep.

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LOOK IN See what is beneath the Surface

We test Coal and Mineral land in any part of North or South America.

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Diamond Drill Contractors

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Pays Less for Drilling Rock

Important economies are sure to follow the equipment of your mine with **Wood Rock Drills.**

Their use means longer and better service. Built of **Vanadium Tungsten Iron** that has many times the wearing properties of cast iron. **Write for the Wood Catalog.**

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McKiernan-Terry Drill Co.

Manufacturers of

Rock Drills, Hammer Drills, Core Drills, Pile Hammers, Atlas Jacks.

230 Broadway, New York

Harbison-Walker Refractories Company

MANUFACTURERS OF

High Grade Silica, Chrome, Magnesia and Fire Clay Brick

IMPORTERS OF

Chrome. Ore and Spaeter Dead-Burned Magnesite

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for night work and the dark places underground

Milburn Portable Acetylene Lights give the most powerful illumination possible to secure in portable units. Their wide-spread white light produces working conditions equal to daylight and secures maximum results from men and machines.

They use ordinary commercial carbide, readily obtainable anywhere in the United States at a low price. They are extremely simple, entirely automatic and require no attention.

Send for Bulletin 26.

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Baltimore - - Maryland

made to order. Either in steel, iron, brass, copper, bronze.
Catalog No. 45.
Multi-Metal Separating Screen Co., 253 W. 19th St., New York City, N. Y.
Bronze and other metals to 350 mesh.

Second-Hand Machinery
Kenyon, Arthur D., Denver, Colo.
Morse Bros. Mach. & Supply Co., Denver, Colo.
See Alphabetical Index for For Sale Ads.

Separators, Magnetic
Buchanan Co., Inc., C. G., 90 West St., N. Y.
Dings Separator Co., Milwaukee, Wis.
Magnetic separators for all purposes.
Zinc Concentrating Co., 60 Congress St., Boston, Mass.
Campbell magnetic separator. Three magnetic fields. Different intensities. High separation and less waste obtained by lightly roasting ore in unlined nonoxidizing kiln. Etherington-Singer.

Sharpeners, Drill
Denver Rock Drill Mfg. Co., Denver, Colo.
Hardsocg Wonder Drill Co., Ottumwa, Iowa.
Ingersoll-Rand Co., 11 Broadway, New York.
Leyner—compact, rapid, simple in operation.
Sullivan Machinery Co., Chicago, Ill., U. S. A.
Sullivan sharpener makes drill bits and drill shanks by hammering throughout; steel is held while upsetting in a compressed-air vise.
High temperature unnecessary.
Bulletin No. 272.

Shears, Hydraulic
Wood & Co., R. D., Philadelphia, Penn.

Sheet Iron Work
Hendrick Mfg. Co., Carbondale, Penn.
Sanford-Day Iron Co., Knoxville, Tenn.

Shovels, Power
Marion Steam Shovel Co., Station D, Marion, O.
All sizes for stripping and mining. Electric, steam or gasoline power.

Skips
Sanford-Day Iron Co., Knoxville, Tenn.
Traylor Eng. & Mfg. Co., Allentown, Penn.
"Bryant-Wethey" type.
Watt Mining Car Wheel Co., Barnesville, Ohio.

Smelters
American Smelting & Refining Co., 120 Broadway, New York.
American Zinc, Lead & Smelting Co., 55 Congress St., Boston, Mass.
Balbach Smelting & Refining Co., Newark, N. J.
Beer, Sondheimer & Co., Inc., 61 Broadway, New York. Cable Address: Beersond.
Fort Smith Spelter Co., Warren, Ohio.
Grasselli Chemical Co., The, Cleveland, Ohio.
Illinois Zinc Co., Peru, Ill.
International Smelting Co., 42 Broadway, New York.
McKechnie Brothers, Ltd., Widnes, Eng. Branches: London, Birmingham, Newcastle, Manchester, Eng.
Matthiessen & Hegeler Zinc Co., La Salle, Ill.
United States Smelting, Refining & Mining Co., 55 Congress St., Boston, U. S. A.
Vogelstein & Co., L., 42 Broadway, New York.

Splice, Cable
American Mine Door Co., Canton, Ohio.

Splice, Insulator
American Mine Door Co., Canton, Ohio.

Splice, Trolley Wire
American Mine Door Co., Canton, Ohio.

Steam and Hydraulic Forging Presses
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Ingersoll-Rand Co., 11 Broadway, New York.
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All shapes and sizes. Solid or hollow. FJAB brand. Made in Sweden.

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Switchboards
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Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.
All types and sizes.

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Pacific Tank & Pipe Co., San Francisco, Calif.
Redwood Mfrs. Co., San Francisco, Calif.

Tapes, Measuring
Lufkin Rule Co., Saginaw, Mich.

Technical Chemicals
Heil Chemical Co., Henry, St. Louis, Mo.

Tees, Pipe
National Tube Co., Pittsburgh, Penn.

Telephones, Mine
Stromberg-Carlson Telephone Mfg. Co., Rochester, N. Y.
Iron-clad magneto equipment compactly assembled in cast-iron box to protect it.

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Up to 350 mesh.

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Conklin, H. R., Joplin, Mo.

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Yuba Construction Co., San Francisco, Calif.

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Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.
All types and capacities.

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Friction grip system with buckets attached to endless pulling rope by friction grips. Also two-bucket or jig-back system.
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Leschen & Sons Rope Co., A., St. Louis. New York, Chi., Denver, Salt Lake, San Francisco.
Roebling's Sons Co., John A., Trenton, N. J.

Tubing
National Tube Co., Pittsburgh, Penn.
Tubing, Shelby seamless steel.

Tungsten
Foote Mineral Co., 101 N. 19th St., Phila., Pa.
Leavitt & Co., C. W., 30 Church St., New York.
Mitsui & Co., Ltd., 25 Madison Ave., New York.
Tungsten ore 65 to 70%.
Direct import from Orient.
Wah Chang Mining & Smelting Co., Woolworth Bldg., New York.

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Primos Chemical Co., Primos, Del. Co., Pa. Cable: "Briquette, Phila." Branches: Vanadium and Lakewood, Colo.
Agents: Allen S. Davison & Co., Pittsburgh, Pa.

Turbines, Steam
De Laval Steam Turbine Co., Trenton, N. J.
General Electric Co., Schenectady, N. Y.
Leffel & Co., James, 306 Lagonda St., Springfield, Ohio, U. S. A.
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Turbines, Water
Pelton Water Wheel Co., San Francisco. New York.
Smith Co., S. Morgan, York, Penn. Branches: Chicago and Boston.

Unions, Pipe
National Tube Co., Pittsburgh, Penn.

Valves
Hardsocg Wonder Drill Co., Ottumwa, Iowa.
Homestead Valve Mfg. Co., Homestead, Penn.
Jenkins Bros., 80 White St., New York. Branches: Boston, Philadelphia, Chicago, Montreal, London.
Sizes for all pressures and purposes.
Brass, iron, cast steel. Also all iron for handling cyanide solutions.
Write for Catalogue No. 20.
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Whitcomb Co., Geo. D., Rochelle, Ill.

Valves, Check
Lunkenheimer Co., The, Cincinnati, O., U. S. A.
National Tube Co., Pittsburgh, Penn.
Wood & Co., R. D., Philadelphia, Penn.

Valves, Gate
National Tube Co., Pittsburgh, Penn.
Wood & Co., R. D., Philadelphia, Penn.

Valves, Globe
Lunkenheimer Co., The, Cincinnati, O., U. S. A.
National Tube Co., Pittsburgh, Penn.

Valves, Pump
Jenkins Bros., 80 White St., New York.
Quaker City Rubber Co., 629 Market St., Phila., Pa.

Valves, Regrinding
National Tube Co., Pittsburgh, Penn.
"N. T. C."

Valves, Rubber Pump
Goodrich Co., The B. F., Akron, Ohio.
Flat circular or spherical, later ¼ to 10 inch diameter.

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Primos Chemical Co., Primos, Del. Co., Pa. Cable: "Briquette, Phila." Branches: Vanadium and Lakewood, Colo.
Agents: Allen S. Davison & Co., Pittsburgh, Pa.

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Pelton Water Wheel Co., San Francisco. New York.

Weighers and Samplers
Pitkin, Inc., Lucius, 47 Fulton St., New York.

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Watt Mining Car Wheel Co., Barnesville, Ohio.

Whistles
Hendrie & Bolthoff M. & S. Co., Denver, Colo.

Wheels and Axles, Car
Sanford Day Iron Co., Knoxville, Tenn.

Wheels, Car
Enterprise Fdry. & Mach. Co., Bristol, Va.-Tenn.
"Enterprise" roller-bearing mine car trucks, for wood and steel cars, all sizes and types, balanced design. Anti-friction roller bearings; no loose caps, bolts or gaskets.

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Ludlow-Saylor Wire Co., St. Louis, Mo.
All meshes and gages. Steel, brass, copper and bronze, galvanized hardware cloth and window screen cloth.
Catalog No. 45.
Multi-Metal Separating Screen Co., 253 W. 19th St., New York, N. Y.
Up to 350 mesh.

Wire, Flat, Round and Special Shape
Roebling's Sons Co., John A., Trenton, N. J.

Wire Rope Fittings
Roebling's Sons Co., John A., Trenton, N. J

Wire Rope Slings
Roebling's Sons Co., John A., Trenton, N. J.

Wrenches, Alligator
Roebling's Sons Co., John A., Trenton, N. J.

Zinc Dust
American Smelting & Refining Co., 120 Broadway, New York.
American Zinc & Chemical Co., Langeloth, Penn.
Atkins, Kroll & Co., San Francisco, Calif.
New Jersey Zinc Co., 55 Wall St., New York.
Vogelstein & Co., L., 42 Broadway, New York.

Zinc, Sheet
Illinois Zinc Co., Peru, Ill.
Matthiessen-Hegeler Zinc Co., La Salle, Ill.

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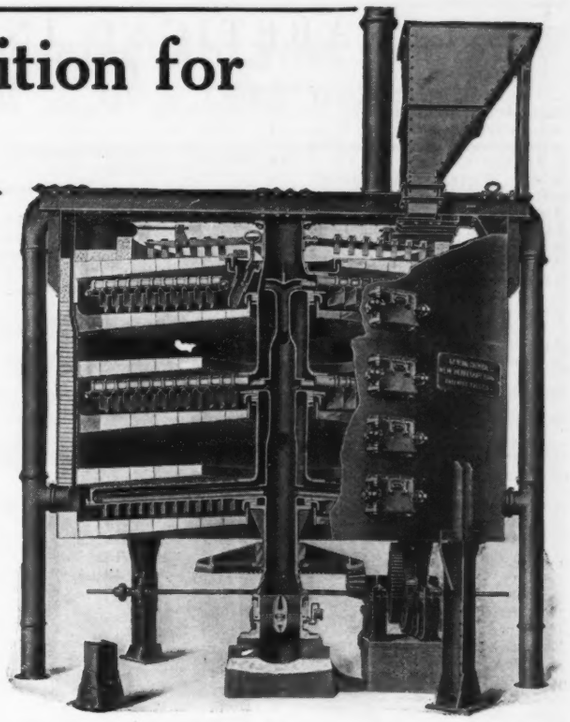
Meets Every Condition for a Perfect Roast



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PATENTED

Low installation and operating cost—high efficiency and large capacity—these are the things you get when you buy a New Herreshoff.

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PACIFIC FOUNDRY COMPANY
18th and Harrison Streets San Francisco California
Pacific Coast Agents

busy? No, BUSY—if you refer to the action of THE CEMENT-GUN in the average mine

There are 8 jobs the Cement-Gun does exceptionally well—so well that no Cement-Gun we know of in mine service has had an "off day" as yet. Here are the jobs:

1—Lines drifts or other horizontal workings in which rock tends to slack or otherwise fall off.

2—Lines a shaft alone or in conjunction with other mixing outfits.

3—Repairs concrete work of all kind. Bring the Cement-Gun to the rescue wherever concrete has cracked, crumbled or split.

4—Waterproofs flumes, tunnels, ditches, etc. with a protective coating.

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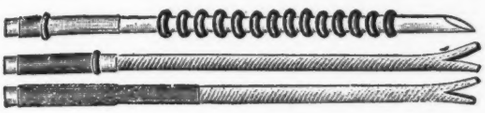

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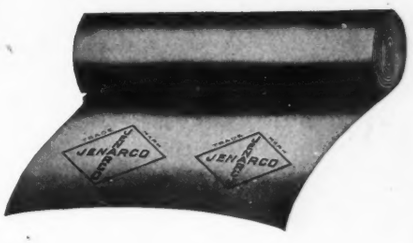

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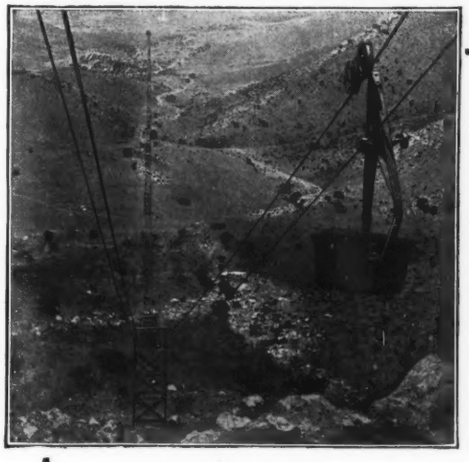

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